



SCIENCE



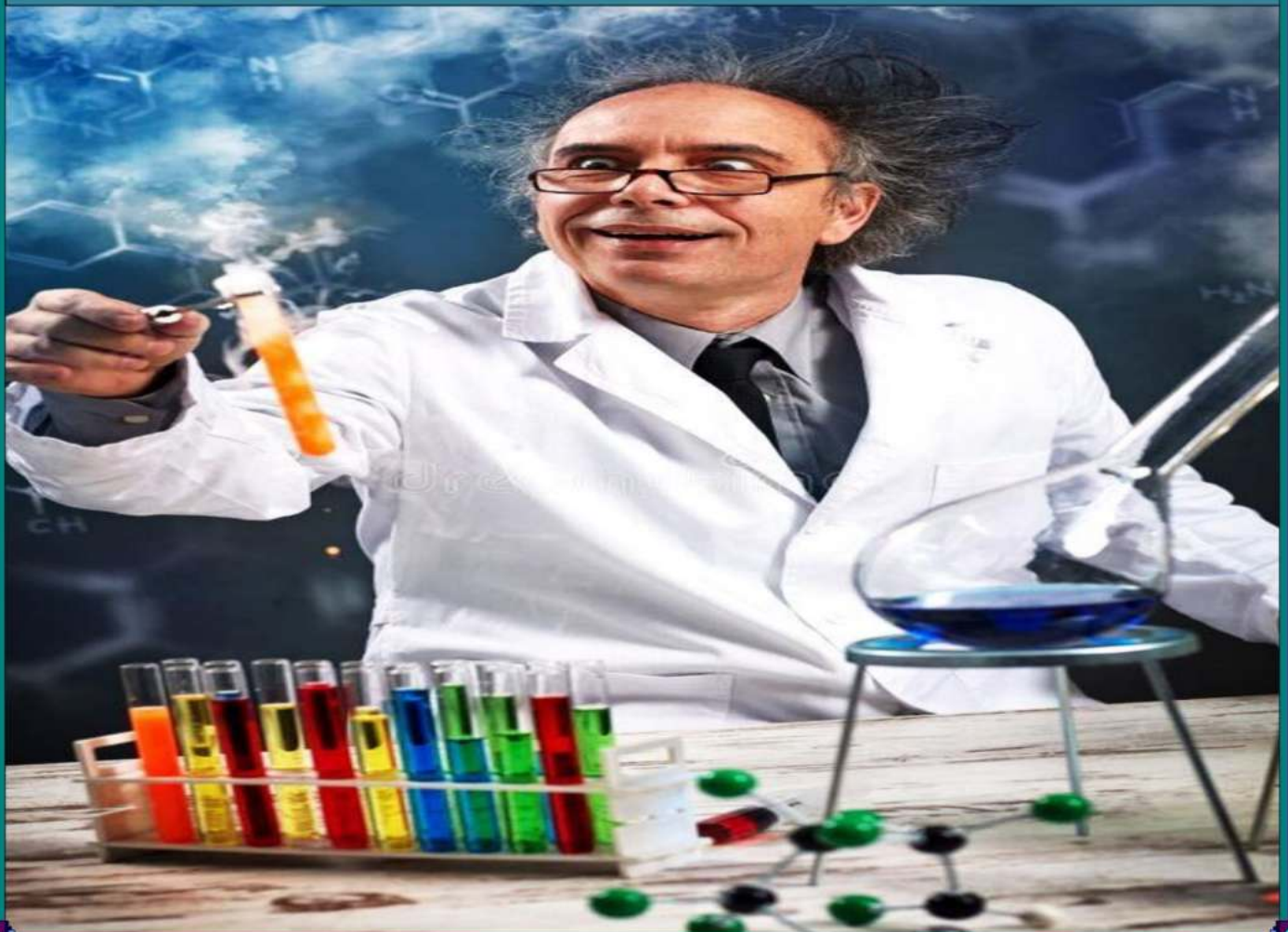
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Grade/Section: _____

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Geel 2000 Language Schools Prep.(2) Unit (1)





Unit (1)



Thermal energy and changes in matter

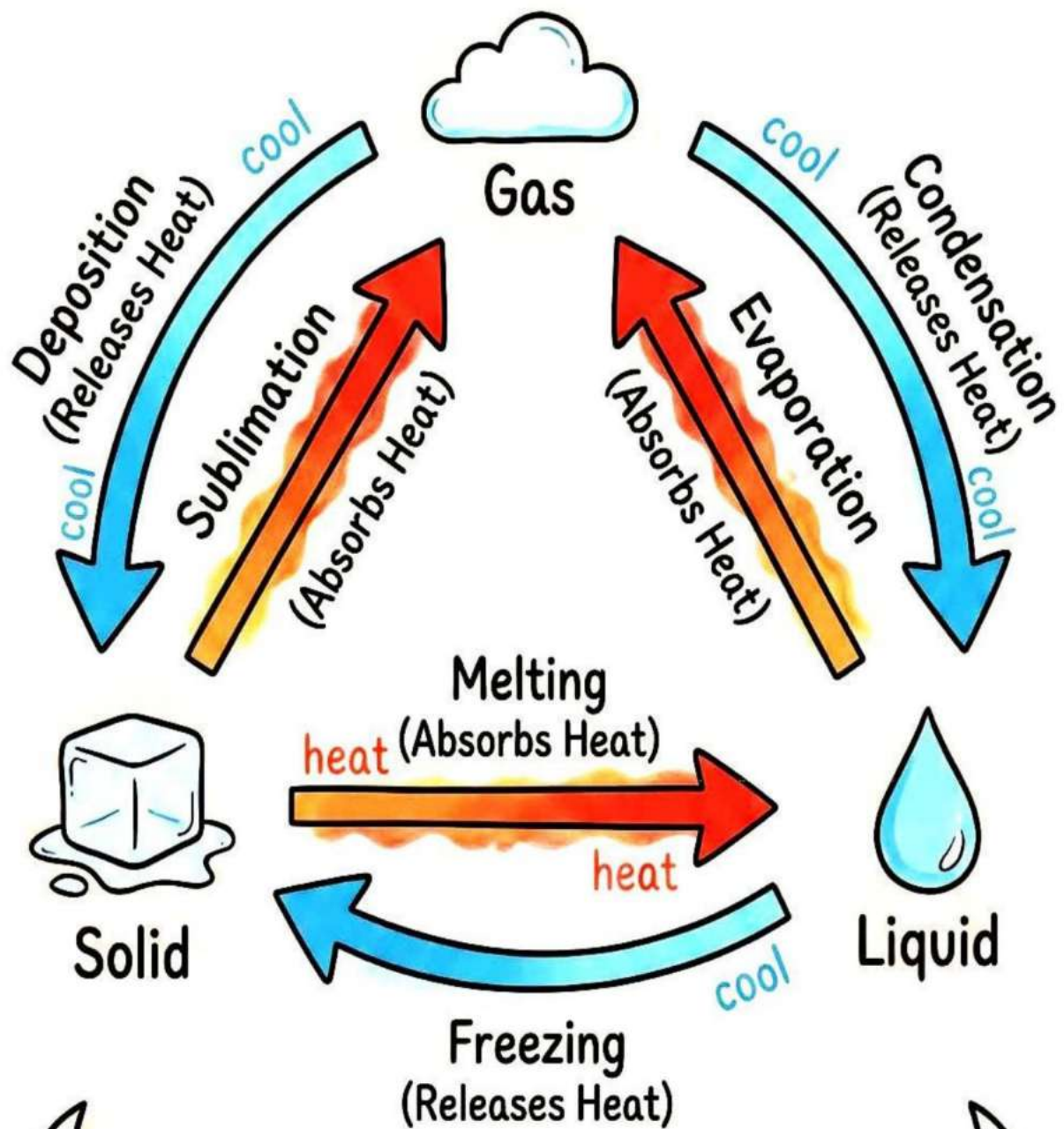
Lesson (1)

Thermal changes accompanying physical change

Endothermic process	Exothermic process
Ex. Antiseptic lotion (heat absorbed)	Washing Powder and Water (heat released)
	
Your hands feel cold with Antiseptic lotion. ? (G.R)	Your hands feel warm with washing powder and water? (G.R)
Because alcohol in the Antiseptic lotion evaporates, absorbed the heat in the hands.	Because heat is released from the washing powder dissolves in the water.



Examples of transformations of states of matter:



Endothermic Processes

Melting, Evaporation,
Sublimation

Exothermic Processes

Freezing, Condensation,
Deposition

The processes in the figure are **reversible processes** that do not involve breaking or forming new bonds,

★ Processes that absorb heat are endothermic:
(melting, evaporation, sublimation).

★ Processes that release heat are exothermic:
(freezing, condensation).



Refrigerator Cooling Cycle

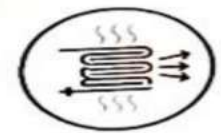
Refrigerator cooling cycle is closed repeating thermal process in which heat is drawn from inside the refrigerator and transferred to the surrounding environment (air) using the (environmentally friendly refrigerant Freon).

THIS CYCLE INCLUDES ENDOTHERMIC AND EXOTHERMIC PROCESSES.

absorbed
heat



released
heat



THE FREON GOES THROUGH SEVERAL STAGES:

1- Expansion and Condensation

The Freon liquid passes under high pressure through a narrow valve, turning into a cold gas that absorbs the heat of the food inside the refrigerator (**endothermic process**)

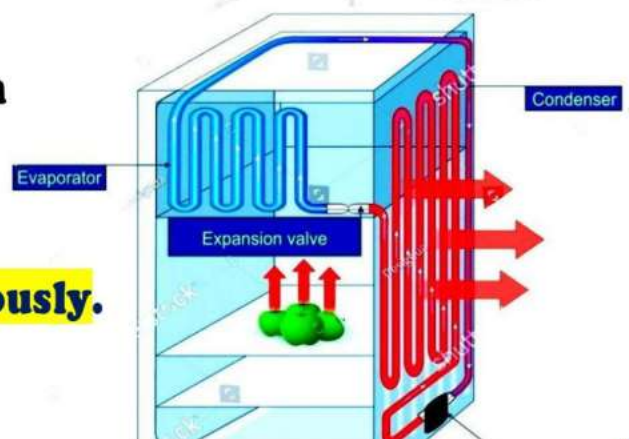
2- Compression.

The compressor (**refrigerator motor**) draws in the gas and compresses it, causing its temperature to rise.

3- The condense

The hot gas passes through a network of pipes located behind the refrigerator, where it cools and turns back into a liquid, accompanied by the expulsion of heat to the surrounding environment (**exothermic process**).

-The cooling cycle repeats continuously.



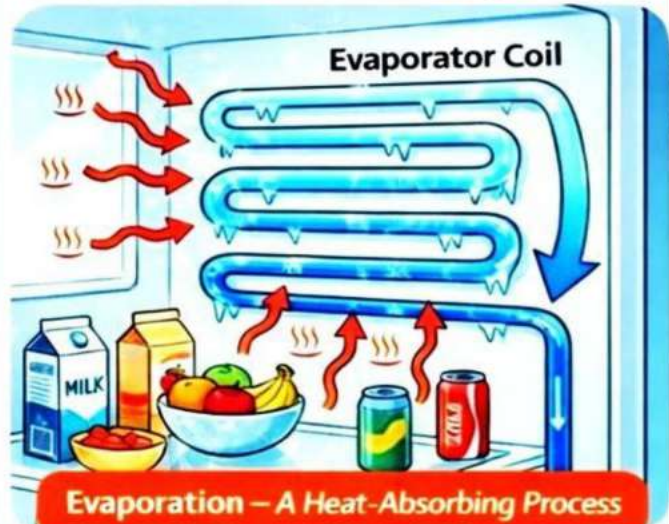
Refrigerator Cooling Cycle

Journey Inside the Refrigerator



Evaporator Coil (Absorbs Heat)

Evaporation – A Heat-Absorbing Process



The refrigerant turns into a gas and absorbs heat from the food inside the refrigerator, making it cold.

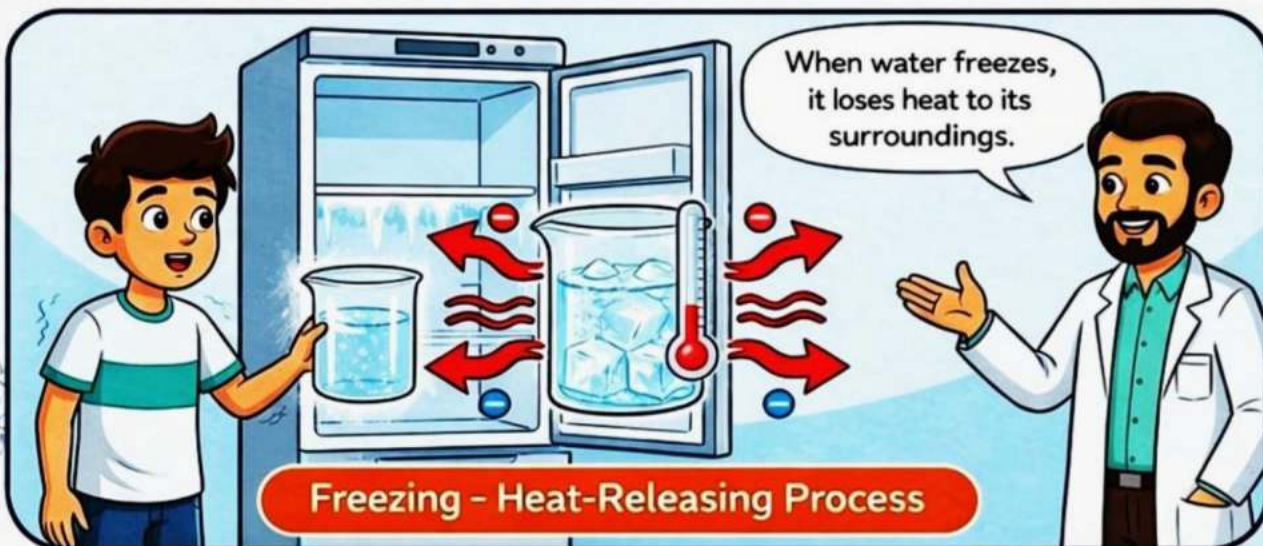
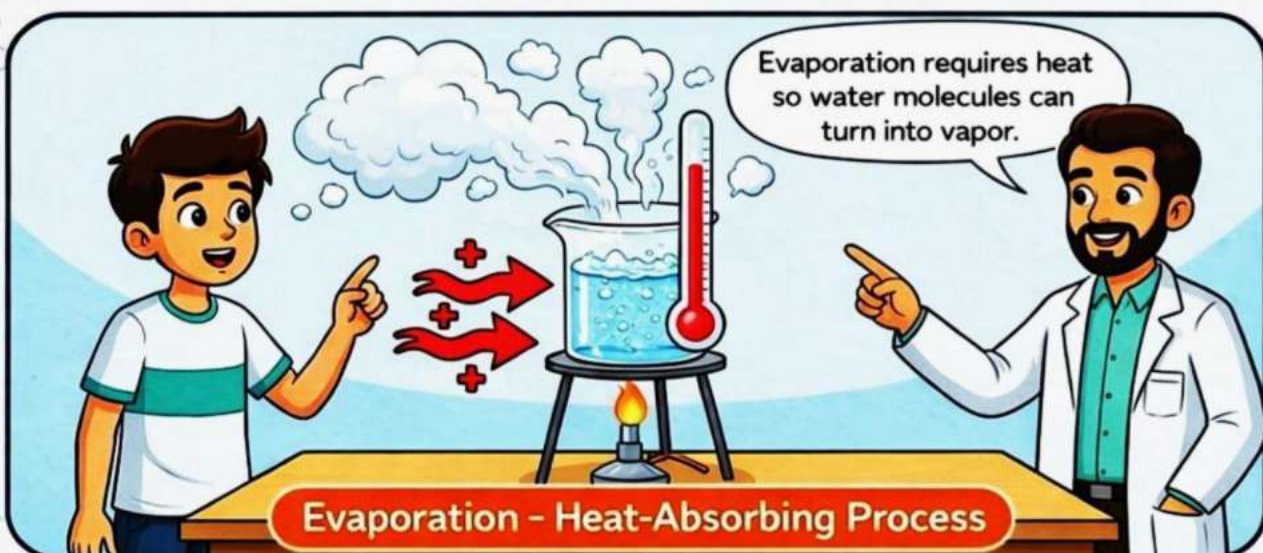
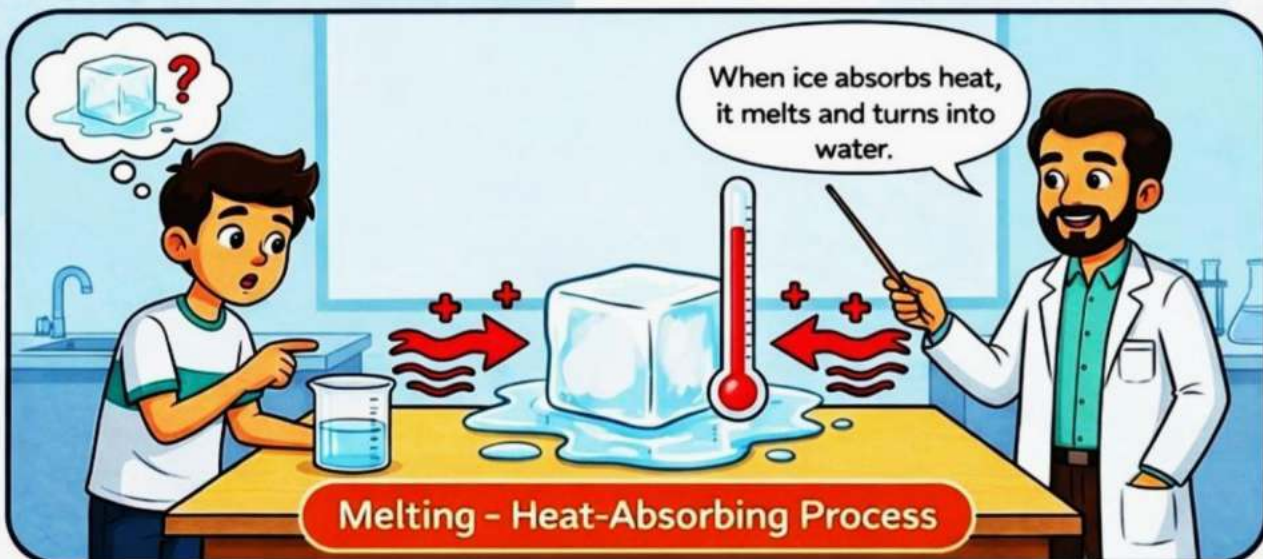
Condenser Coil (Releases Heat)

Condensation – A Heat-Releasing Process



The refrigerant gas turns back into a liquid and releases the absorbed heat into the outside air behind the refrigerator.

Heat-Absorbing and Heat-Releasing Processes



Thermal changes accompanying the dissolution process

The thermal change accompanying the dissolution process depends on **the type of substance** dissolved in the solvent (water).

Activity (1): Effect of dissolution on temperature and determine whether the process is endothermic or exothermic

Steps ★ Add 4 gram sodium hydroxide $\text{NaOH}_{(s)}$ to 100 ml of water with an initial temperature (T_1) inside two nested heat-insulating polystyrene cups, stirring gently with a glass rod, final temp. (T_2) is recorded after 15 sec.

★ Add 8 gram of Ammonium Nitrate $\text{NH}_4\text{NO}_3(s)$ to 100 ml of water with an initial temperature (T_1) inside two nested heat-insulating polystyrene cups, stirring gently with a glass rod, final temp. (T_2) is recorded after 15 sec.

Observation:

★ $T_2 > T_1$ (in sodium hydroxide)

★ $T_2 < T_1$ (in Ammonium).

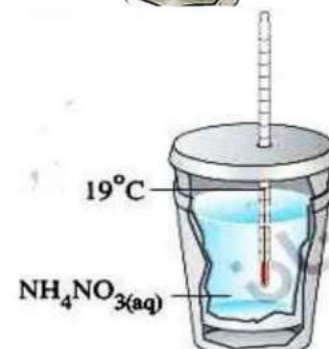
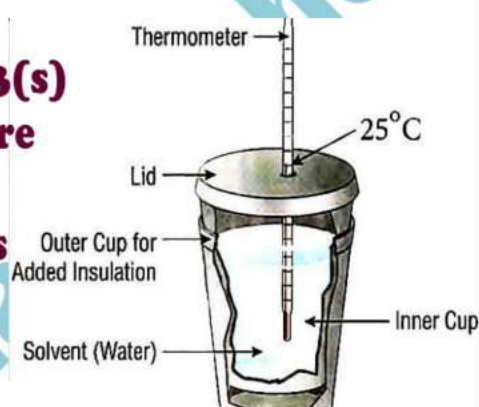
Conclusion:

★ Dissolution of some substances cause the release of heat energy to the surroundings.

(Exothermic dissolution)

★ Dissolution of some substances cause the absorption of heat energy from the surroundings.

(Endothermic dissolution)

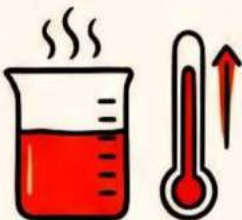


Substance	Type of Dissolution	Heat Exchange	Temperature Change
NH_4NO_3	Endothermic	Absorbs heat	Decreases
NaOH	Exothermic	Releases heat	Increases

Note: The thermal insulation in the experiment can be increased by increasing the number of polystyrene cups used.



Heat of Dissolution: Exothermic vs. Endothermic

	Exothermic Dissolution	Endothermic Dissolution
Definition	Releases thermal energy to surroundings.	Absorbs thermal energy from surroundings.
Temperature Change	Final temp (T_2) > Initial temp (T_1). Temp rises. 	Final temp (T_2) < Initial temp (T_1). Temp drops. 
Experimental Example	Dissolving Sodium Hydroxide (NaOH) in water.	Dissolving Ammonium Nitrate (NH₄NO₃) in water.
Other Examples	KOH, CaCl₂, Na₂CO₃, Anhydrous CuSO₄.	K₂SO₄, NaHCO₃, Hydrated CuSO₄·5H₂O.

Heat of dissolution

It is the amount of heat absorbed or released when a given amount of solute dissolves in a given volume of solvent to form the constituents.

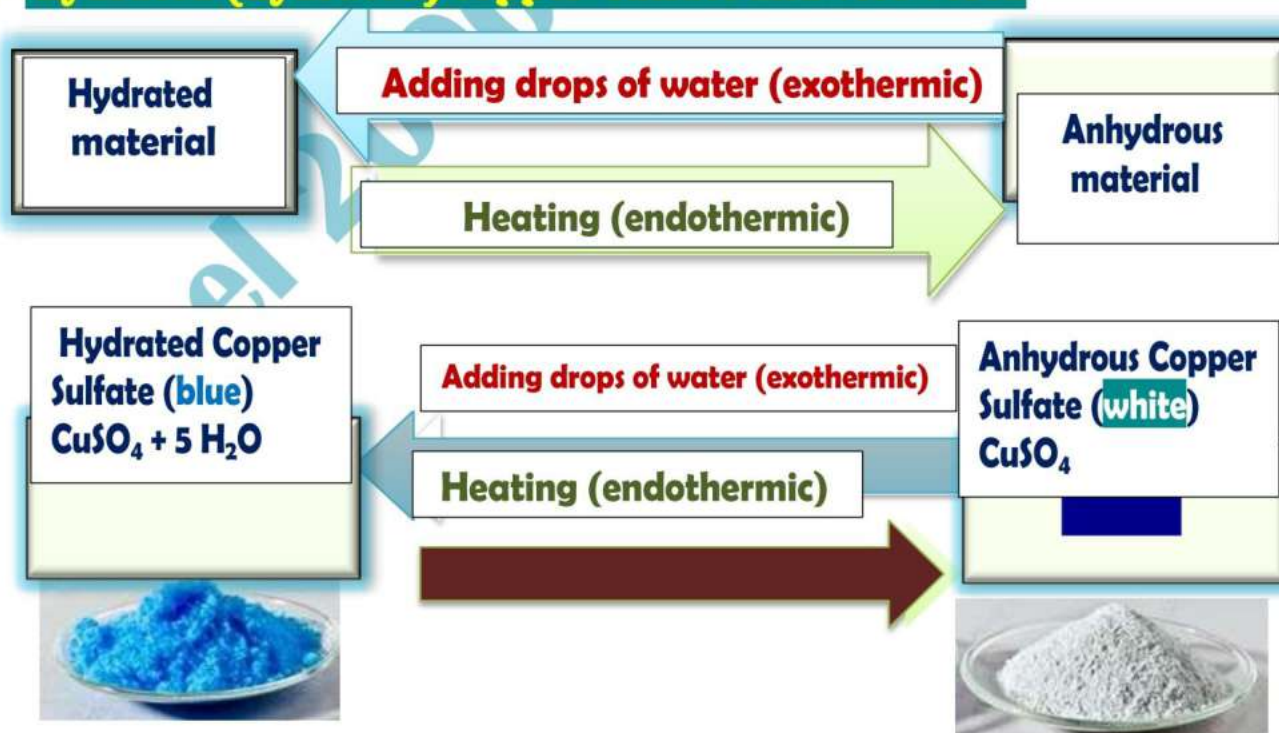
Exothermic		Endothermic	
Sodium hydroxide	NaOH	Ammonium Nitrate	NH ₄ NO ₃
Calcium chloride	NaCl ₂	Potassium Sulfate	K ₂ SO ₄
Sodium carbonate	Na ₂ CO ₃	Sodium Bicarbonate	NaHCO ₃
Anhydrous copper Sulfate	CuSO ₄	Hydrated Copper Sulfate	CuSO ₄ .5H ₂ O

Hydrated: The molecules of some materials are bonded to a specific number of water molecules in an exothermic process, and such materials are known as (hydrated)

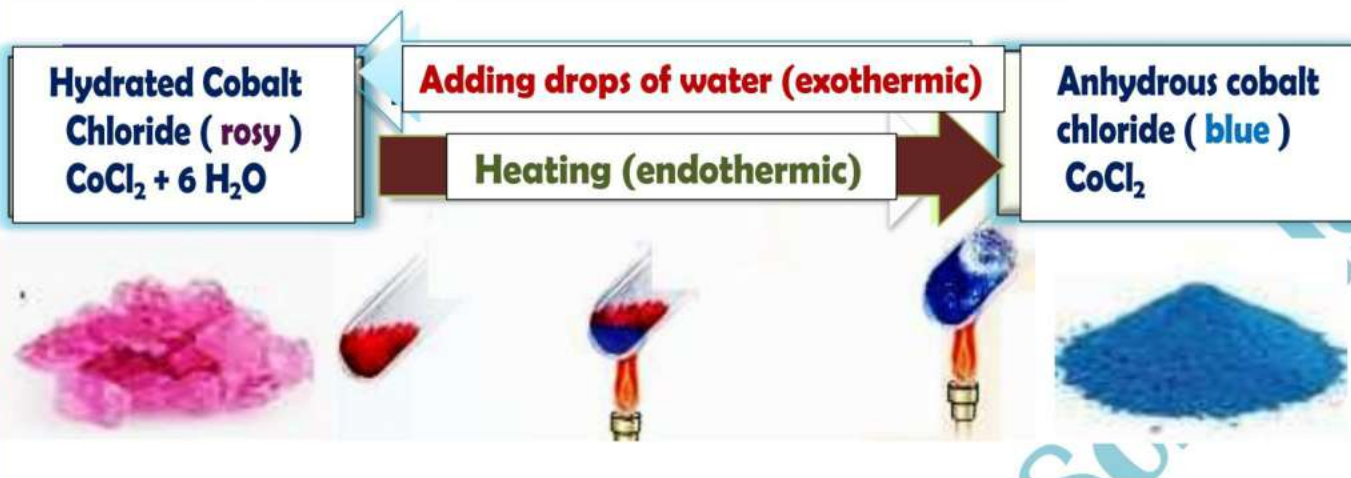
Anhydrous water molecules can be removed from hydrated materials by heating in an endothermic process to become non-hydrated (anhydrous) molecules.

The non-hydrated molecules can return to their hydrated state again by adding drops of water to them.

- 1- Conversion of non-hydrated (anhydrous) copper sulfate to
- 2- hydrated (hydrated) copper sulfate and vice versa



2- Conversion of non-hydrated (anhydrous) cobalt chloride to hydrated (hydrated) cobalt chloride and vice versa.



The danger of adding water to concentrated acid.

The concentrated acid drips on the walls of container of water, not the other way.

Because adding water to concentrated acid releases a **large amount of heat energy**, leading to an immediate and violent boiling of the water and the spraying of acid outside the reaction container, which can cause serious damage.

! Safety Precaution: Diluting Acids



Correct: Add Acid to Water slowly.



Incorrect: NEVER add Water to Acid (Violent boiling!)

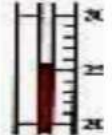
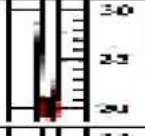
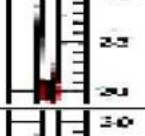
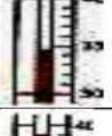
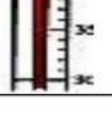
Reason: Adding water to concentrated acid releases huge thermal energy, causing violent boiling and splashing.

The relationship between the heat change associated with the dissolution process and the mass of the solute.

Activity (2) An experiment determines the magnitude of the heat change associated with the dissolution of 18% of non-hydrated lithium chloride salt (LiCl (s) (solute) in 30% distilled water (solvent) -Repeat the experiment by using different masses of dissolved LiCl salt (1g,2g,3g,4g) constant volume of water (30% distilled water) Record the initial temperature (T₁) and the final temperature (T₂) for each case.

Calculate the magnitude of the temperature change in each case.

- Temperature change is calculated using: $\Delta T = T_2 - T_1$

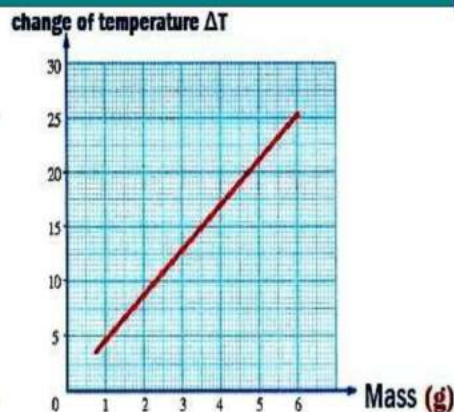
Experiment	Mass of salt used	Initial temperature (T ₁)		Final temperature after 30s (T ₂)		change of temperature ΔT
1	1 gram		21°C		25.5°C	25.5 - 21 = 4.5°C
2	2 gram		21°C		30°C	30 - 21 = 9°C
3	3 gram		21°C		34°C	34 - 21 = 13°C
4	4 gram		21°C		39°C	39 - 21 = 18°C

► Conclusion

- As the mass of lithium chloride increases, the temperature change increases.
- This means that more heat is released when a larger mass of solute dissolves.
- Therefore, the dissolution of anhydrous lithium chloride in water is an exothermic process.

Variables in the Experiment

- Independent variable: Mass of anhydrous lithium chloride (solute)
- Dependent variable: Temperature change (ΔT)
- Controlled variable: Volume of water (solvent)



Give reason:

The dissolution of anhydrous lithium chloride salt in water is exothermic

Because it is accompanied by a rise in the temperature of the solution (system), indicating that heat is released.

★ The amount of heat energy released or absorbed during dissolution process is directly proportional to the mass of the solute dissolved in a given constant volume of the solvent (water).

★ Doubling the mass of the solute, while keeping the volume of water constant, leads to a doubling of the temperature change

Dissolving Endothermic	Dissolving Exothermic	Comparture in a beicer
Salt 25°C 10°C Temperature drops	Chemical Substance 25°C 50°C Temperature rises	Water-Soluble H_2O H_2O Dissolving Hydration Contains water molecules in its crystal structure.

Instant cold and hot packs

Instant packs are used only once.



They consists of:

- **Flexible bag containing:**

★ **Water.**

★ **A chemical substance (solute) inside a thin inner bag.**

- **When the pack is pressed, the inner bag breaks.**

- **The solute mixes with water and dissolution occurs, causing :**

◇ **Absorption of heat (cold pack) or**

◇ **Release of heat (hot pack).**

Instant Cold and Hot Packs

Ouch, an injury on the field!

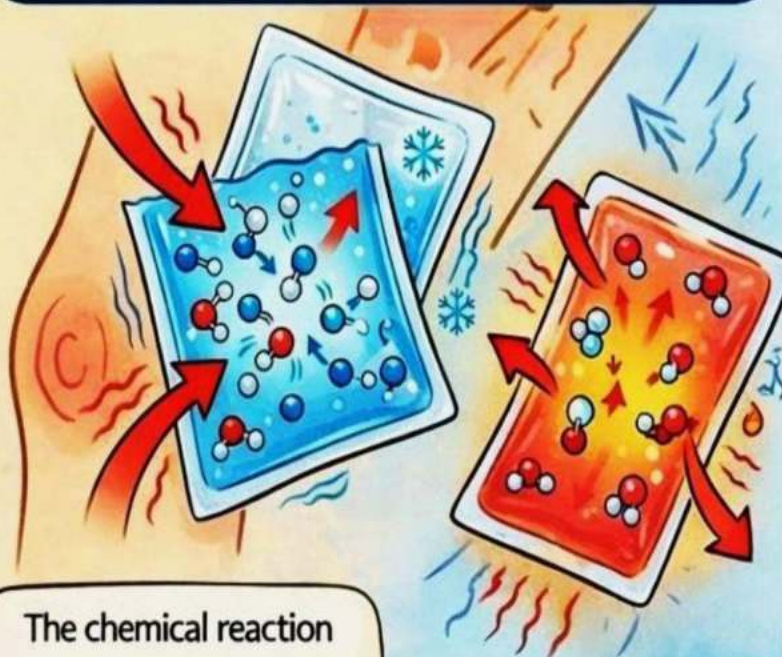


Sam asks: "How do cold packs work?"

Instant Cold Pack (Absorbs

Instant Cold Pack (Absorbs Heat)

Endothermic Reaction – A Heat-Absorbing Process

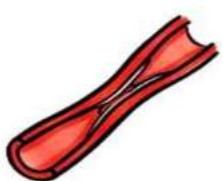


The chemical reaction absorbs your body's thermal energy, making it feel cold.

The chemical reaction **releases** thermal energy, producing heat to relieve pain.

Instant Hot Pack (Releases Heat)

Types of instant packs

	Instant Hot Compress	Instant Cold Compress
Chemical Used	Magnesium Sulfate (MgSO_4).	Ammonium Nitrate (NH_4NO_3).
Thermal Change	Exothermic dissolution (Releases Heat).	Endothermic dissolution (Absorbs Heat).
Use Case	Relieving pain from muscle strain. 	Relieving severity of swelling. 
Mechanism	Dilates blood vessels, increasing blood flow, relaxing muscles. 	Constricts blood vessels, reducing blood flow, decreasing swelling. 

WHY?

- Because they cause vasodilation (widening of blood vessels),
- This increases blood flow to the affected area,
- Which helps muscles relax and reduces pain.

WHY?

- Because they cause vasoconstriction (narrowing of blood vessels),
- This reduces blood flow to the injured area, Which helps to decrease swelling.

Lesson (2)

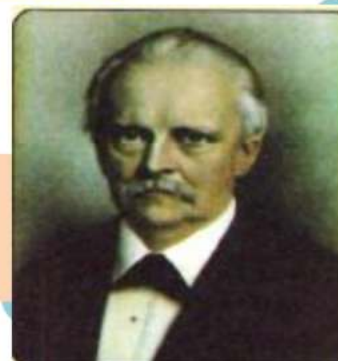
Thermal changes accompanying chemical changes

Law of conservation of Energy:

Energy cannot be created or destroyed but it can be transformed from one form to another.

Hermann von Helmholtz

German scientist proved that energy cannot be created or destroyed and the total energy remains constant within the isolated system.



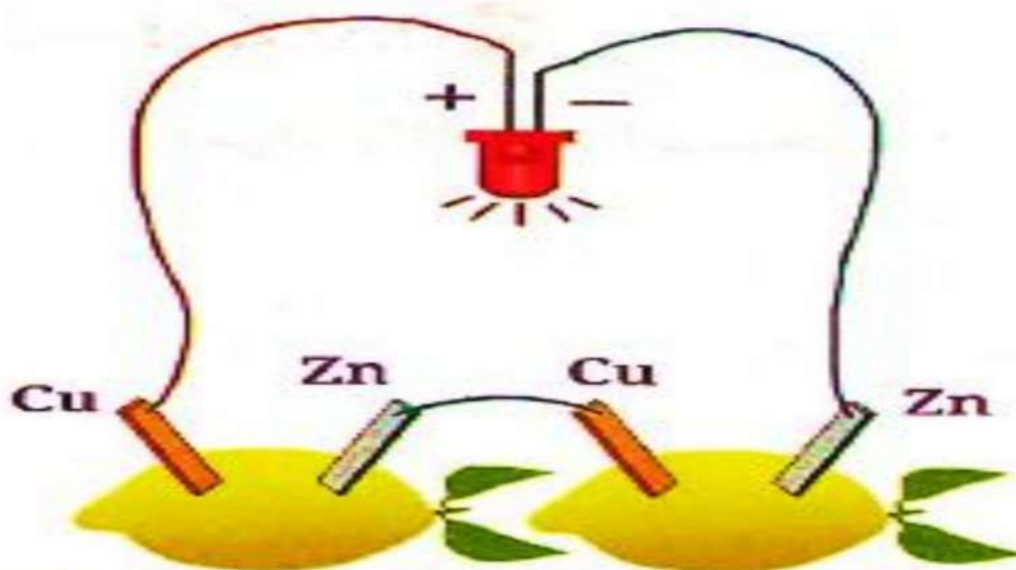
Activity

Steps :

- ① Insert copper rod and a zinc rod into each lemon.
- ② Connect the zinc rod in the first lemon to the copper rod in the connecting wire.
- ③ Connect each of the other copper and zinc rods ends the LED bulb.

Observation : The bulb lights up.

Conclusion : The chemical energy stored in the lemon is converted into electrical energy.



Chemical reactions are classified according to accompanying thermal changes into:

Exothermic and endothermic reactions

1- Exothermic reactions:

Reactions release thermal energy as a product of the reaction into the surrounding environment, raising its temperature.

Activity :

Steps :

- 1- Place 50 ml of dilute hydrochloric acid in a cup of polystyrene.
- 2- Record the initial temperature 7°C
- 3- Immerse the magnesium strip in the acid, stirring gently by glass stem.
- 4- Record the final temperature (T_2)

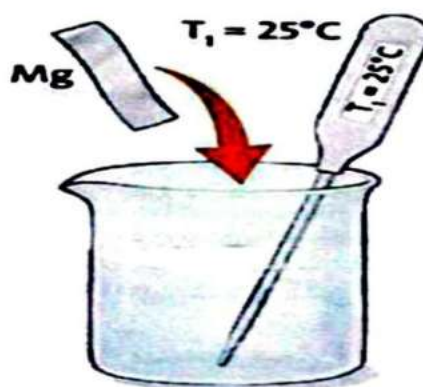
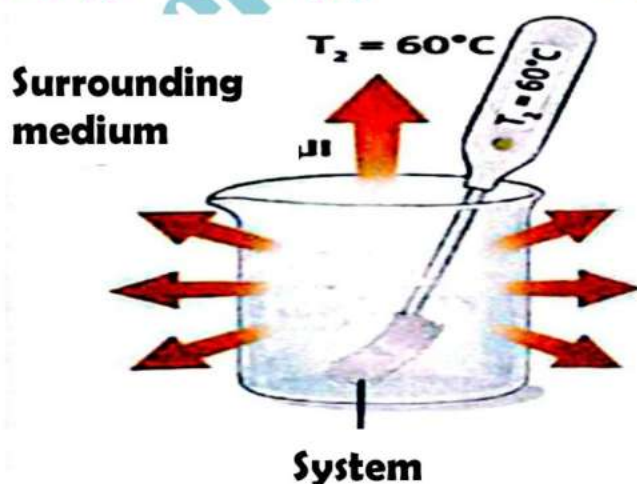


Observation :

Final temperature $T_2 >$ initial temperature T_1

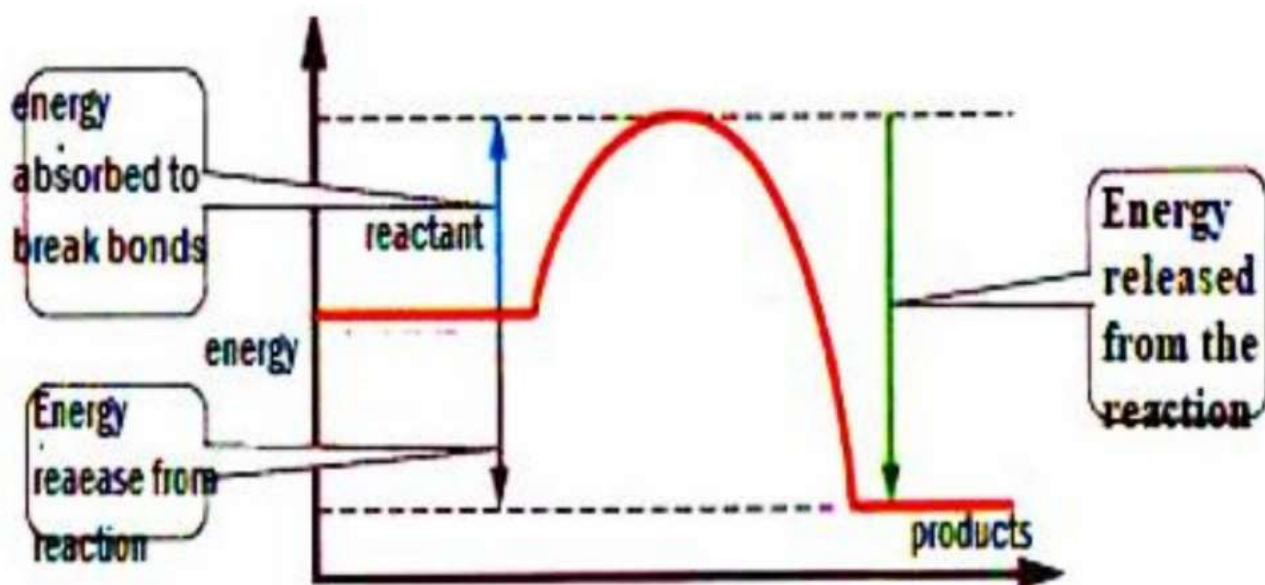
Conclusion

The reaction of magnesium with dilute hydrochloric acid is accompanied by the release of heat energy so the system temperature increases and increases the surrounding temperature (Exothermic reaction)



Note: In exothermic reaction the amount of energy released from the formation of new bonds is more than the amount of energy absorbed when bonds are broken in the reactant molecules.

The difference between them appears as heat energy released from the reaction.

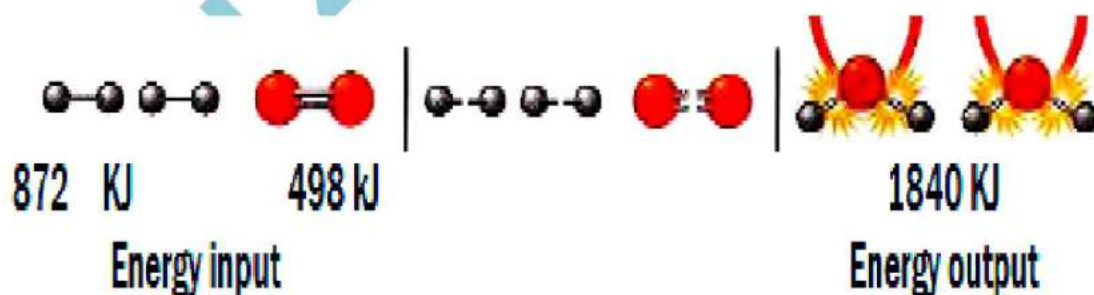


Examples on exothermic reactions :

- 1- Reaction of metals with dilute acids.
- 2- Reaction of alkalis with acids.
- 3- Reaction of metal carbonates with dilute acids.

Application :

The reaction of hydrogen gas with oxygen gas to form water.



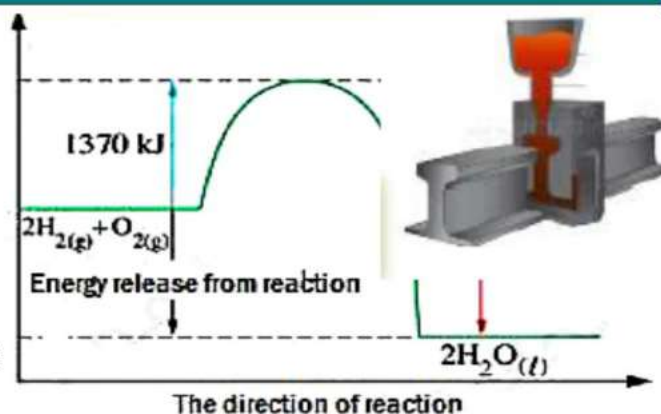
Total energy absorbed when bonds are broken (energy input) = $872 + 498 = 1370$ kJ

Total energy released when bonds are formed (energy output) = 1840 KJ

Life applications :

1- Instant self-heating containers

-It containing an inner funnel with calcium oxide (CaO)(quicklime) and water ,separated by a thin membrane



How it works?

When the lower key of the cup is pressed, the thin membrane produce an exothermic chemical reaction ($\text{CaO} + \text{H}_2\text{O}$) to form calcium hydroxide solution (lime water) with release of heat.



Importance: preparing coffee or heating foods in it, using the heat released from the reaction without need for an external heat source.

Note : The common name for calcium hydroxide powder $\text{Ca}(\text{OH})_2(\text{s})$ is slaked lime.



2-Thermite Reaction

The reaction of aluminum (Al) with red iron oxide (Fe_2O_3) is accompanied by the release of a large amount of heat energy, leading to the melting of the iron produced by the reaction .



Importance:

This reaction is used in the welding of railway rails.

Integration with life Sciences (Biology)

-Fireflies emit light from their abdomen as a result of exothermic chemical reactions within their bodies.

-Most of the energy produced is converted into light.

These insects control the timing and duration of their light for mating or self defense.



2-Endothermic reaction

-Reactions that require the absorption of thermal energy from the surrounding environment ,so decrease its temperature.

Activity :

Steps :

- 1-Moisten a piece of wood with a little Water.
- 2- place a glass flask containing barium hydroxide powder on the piece of wood.
- 3- Record the initial temperature of the powder using a digital thermometer.
- 4- Add ammonium chloride powder to the flask and stir the mixture well with the glass rod.
- 5- Record the final temperature.
- 6- lift the flask off the piece of wood.



Observation :

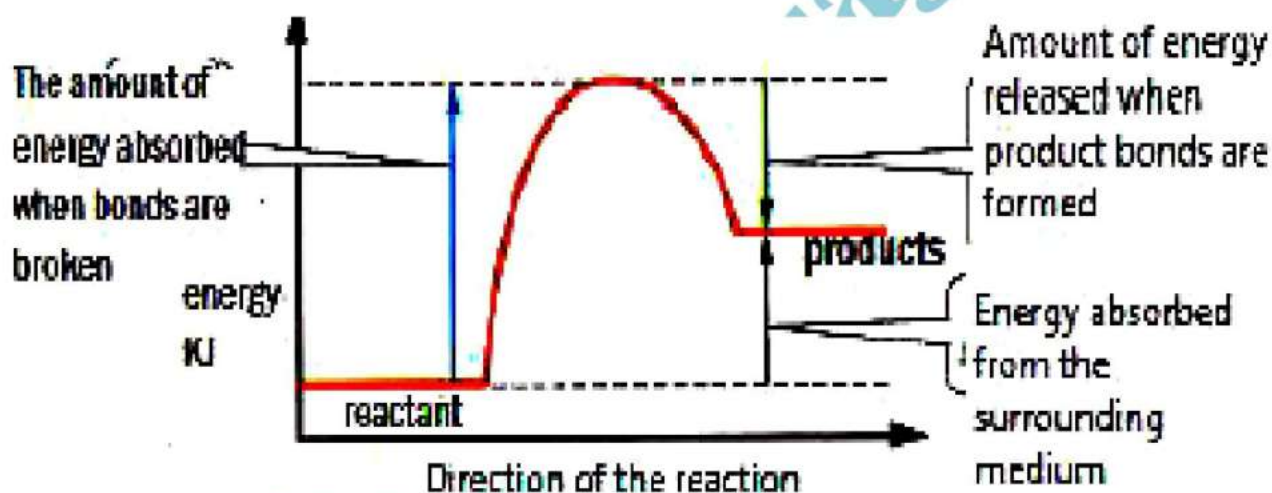
Final temperature $T_2 < \text{Initial Temperature } T_1$ and the flask sticking to the piece of wood.

Examples on endothermic reactions:

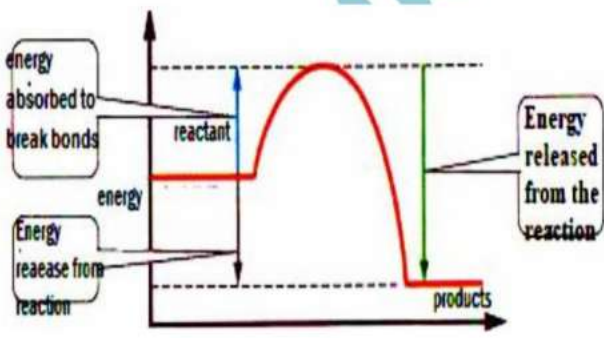
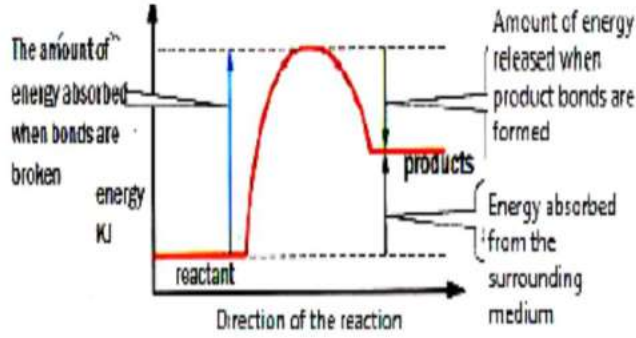
- 1-The thermal decomposition of limestone into calcium carbonate (CaCO_3).
- 2-The decomposition of ozone gas (O_3) in the atmosphere.
- 3-The reaction of sodium bicarbonate with dilute acids .

Note :-

- All thermal decomposition reactions are endothermic reactions.
- In endothermic reactions, the amount of energy released from the formation of new bonds is smaller than the amount of energy absorbed when bonds are broken .



Compare between the exothermic and endothermic

Exothermic Reaction	Endothermic Reaction
Reaction that results in release of thermal energy as a product of the reaction into surrounding environment, so raising its temperature.	Reactions that require the absorption of thermal energy from the surrounding environment ,so decrease its temperature.
Examples: 1-Reaction of metals with dilute acids. 2-Reaction of alkali with acids. 3-Reaction of metal carbonate with dilute acids.	Examples: 1-Thermal decomposition reaction of calcium carbonate. 2-The decomposition reaction of ozone gas in atmosphere. 3-Reaction of sodium bicarbonate with dilute acids.
The amount of energy released from the formation of new bonds is more than the amount of energy absorbed when bonds are broken in the reactant molecules.	The amount of energy released from the formation of new bonds is smaller than the amount of energy absorbed when bonds are broken in the reactants molecules .
The reaction releases thermal energy equal to the difference between the amounts of energy released and absorbed.	The reaction absorbs thermal energy equal to the difference between the amount of energy released and absorbed.
	



Combustion, Oxidation, and Reduction

Combustion

It is a rapid chemical reaction between a flammable substance (Fuel) and an oxidizing agent (usually Oxygen), resulting in the emission of energy in the form of heat and light.

- **Combustion is considered an exothermic reaction ?**
- Because it releases thermal energy into the surroundings.

This lecture discusses

Combustion and does not react repulsively chemically, in addition to its obligations, types and types with its connection to nutrient content and reduction and its applications in daily life and technology

The Essential Elements of Combustion (The Fire Triangle)

For the combustion process to occur, three essential elements must be present. These are known as the Fire Triangle (Combustion Triangle):

1. Fuel: The flammable substance that oxidizes and releases energy.
2. Oxygen Gas: The oxidizing agent necessary for the reaction.
3. Heat: The energy required to start the reaction



Fuel

Flammable materials used to produce thermal energy as a result of an exothermic reaction.

If any side of this triangle is removed, the combustion process stops.

Fuel comes in many forms, including:

1. Fossil Fuels : Such as coal, oil, and natural gas. Although it is a non-renewable resource, it is the most widely used in the world to date.

The two primary fuels used in homes are:

Natural Gas:

Composed mainly of Methane gas (93%) in addition to some other hydrocarbons like Propane and Butane.

Butagas (LPG):

Composed of a mixture of Propane and Butane after separating them from natural gas.

Safety Awareness:

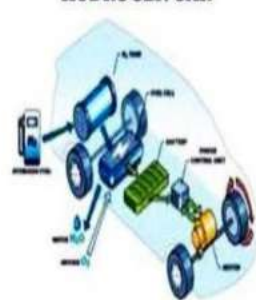
A very small percentage of Ethanethiol gas (which has a garlic scent) is added to both Natural Gas and Butagas) both of which are odorless(to allow for appropriate safety measures in case of gas leaks.



2. Biofuel :

Such as Ethyl Alcohol (Ethanol), which is prepared from starch-rich plants like corn. Therefore, it is considered a renewable resource and is mixed with gasoline in some countries to be used as car fuel.

HYDROGEN CAR



3. Synthetic Fuel :

Such as Hydrogen gas, which is described as the fuel of the future and is used as fuel for cars and trucks powered by fuel cells (Hydrogen Fuel Cells).

This value is a measure of fuel efficiency.

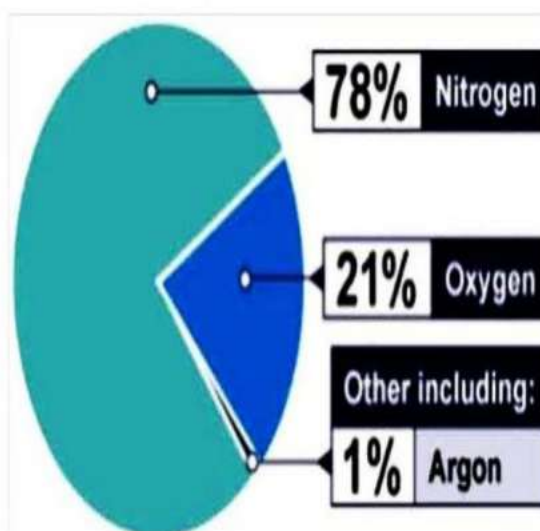
- This is the amount of energy (in Kilojoules kJ) produced by the complete combustion of 1 gram of fuel in an abundance of oxygen gas.

Fuel	Calorific Value (kJ/g)
Wood	20
Ethanol	30

Oxygen Gas

Oxygen is the decisive element in the combustion process, and the speed and efficiency of combustion depend directly on its concentration.

Composition of Atmospheric Air:



Effect of Oxygen Concentration on Combustion Speed:



Q: Does a piece of steel wool burn faster in air (21% oxygen) or in an atmosphere of pure oxygen (100% oxygen)?

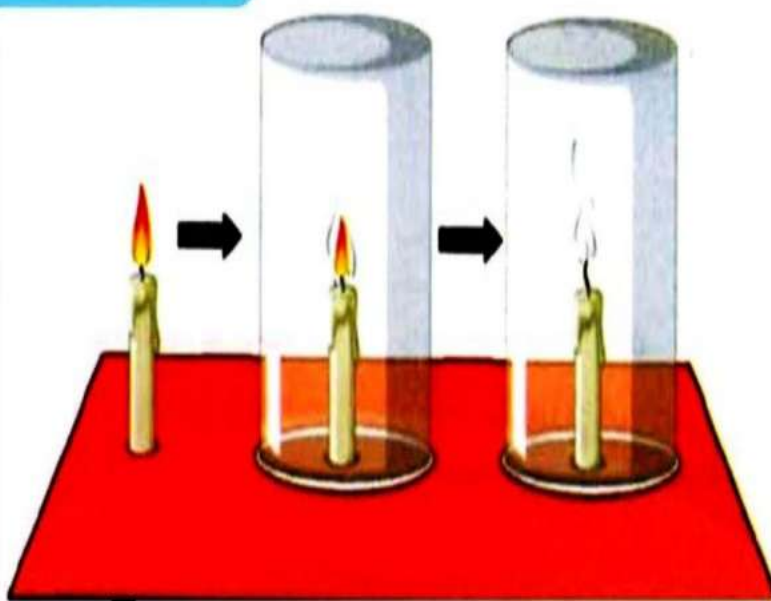
A: The steel wool burns much faster in an atmosphere of pure oxygen.

Explanation:

Increasing the oxygen concentration increases the number of oxygen molecules available to react with the fuel, which increases the rate of the chemical reaction (combustion), making it faster and more intense.

Practical Activity:

1. When a burning candle is placed under a glass bell jar, it extinguishes after a short period.

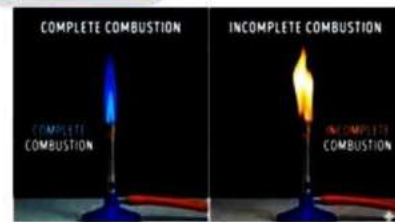


Explanation:

- The main reason the candle extinguishes is the depletion of oxygen gas inside the glass jar. The candle continues to burn as long as oxygen is available. When the oxygen inside the jar is consumed, the fire triangle is disrupted (the oxygen side is removed), leading to the cessation of the combustion process and the extinguishing of the candle.

Types of Combustion (Complete and Incomplete)

- The Bunsen burner is used in laboratories as a practical example to study different types of combustion based on oxygen abundance.



Comparison	Complete Combustion	Incomplete Combustion
Definition	Combustion occurs when oxygen is available in sufficient quantity for all fuel molecules to combine with it.	Combustion occurs when the amount of oxygen is limited. The fuel cannot burn completely.
Oxygen Availability	High abundance of oxygen (Air vent open).	Limited quantity of oxygen (Air vent closed/restricted).
Flame Color	Blue	Yellow or Orange
Thermal Efficiency	Very high (produces a large amount of heat).	Low (produces less heat).

Heat

Heat is the third and final side of the fire triangle; it is the energy required to initiate the combustion reaction.

Ignition Temperature: The lowest temperature the fuel must reach to start burning.

Importance : The lower the ignition temperature of the fuel, the higher its flammability, which determines the danger level of its use and storage.

Practical Example :

Spark plugs are used in car engines to provide the necessary spark to ignite the mixture of gasoline and air in the combustion chamber to start the engine.





Technological Application: Oxy-acetylene Flame

- Used for cutting and welding metals (such as steel and copper).
- This flame is produced by the complete combustion of acetylene gas in an abundance of pure oxygen gas.
- The temperature of the resulting flame reaches about 3000 C which is sufficient to melt metals.



Chemical Reaction of Combustion (Example: Methane)

The combustion of hydrocarbons (like Methane CH_4 , the primary component of natural gas) in air leads to the formation of carbon dioxide gas and water vapor through an exothermic reaction



Spontaneous Combustion:

A phenomenon where a flammable material ignites without an external heat source (such as a flame, electrical spark, or friction).



Cause:

- It occurs as a result of a spontaneous exothermic chemical reaction, where the heat generated by this reaction accumulates until the material's temperature reaches its ignition temperature.



Lab Example:

- When drops of glycerin are added to potassium permanganate powder, a spontaneous exothermic reaction occurs, leading to self-ignition with the release of purple smoke.



Lab Example:

- Spontaneous combustion can occur in piles of wet straw or hay due to the activity of decomposition bacteria, which gradually raises the temperature of the material until it reaches the ignition point.



Fire Extinguishing (The Extinguishing Triangle) X

- Fire extinguishing relies on the principle of removing one of the sides of the fire triangle.
- This principle is known as the Extinguishing Triangle.

The Basic Principles of Fire Extinguishing are:



1. Isolating Oxygen (Smothering)

- This is done by preventing oxygen from reaching the burning material.
- Methods : Using fire extinguishers containing foam, dry powder, or carbon dioxide gas (CO_2) which isolates the fire from the air. Sand is also used to extinguish fires of certain metals like sodium and magnesium.



**Safety Precaution :**

It is strictly forbidden to use water to extinguish sodium or potassium metal fires because these metals react with water in an exothermic reaction accompanied by the ignition of the rising hydrogen gas, which increases the intensity of the fire.

**2. Cooling (Reducing Heat)**

- This is done by reducing the temperature of the burning material to below its ignition temperature.
- Methods : Using water due to its high specific heat, making it effective in absorbing heat and cooling solid materials like paper and wood.

**Safety Precaution :**

It is forbidden to use water to extinguish oil fires because oil floats on the surface of the water (due to its density being lower than water), which leads to the fire spreading instead of being extinguished.

**3. Removing Fuel**

- This is done by removing the flammable material from the fire area, such as closing gas valves when fires occur.

Oxidation and Reduction

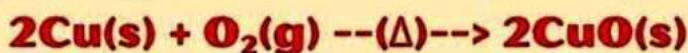
- Combustion reactions are described as oxidation-reduction (Redox) reactions.
- Oxidation and reduction are concurrent chemical processes that happen at the same time.

1. Oxidation Process:

- A chemical process that leads to an increase in the percentage of oxygen in a substance or a decrease in the percentage of hydrogen in it.

Example : Oxidation of Copper :

- When a stream of air is passed over heated copper powder (Cu) (heated to redness), the copper combines with atmospheric oxygen to form the black compound Copper Oxide (CuO).



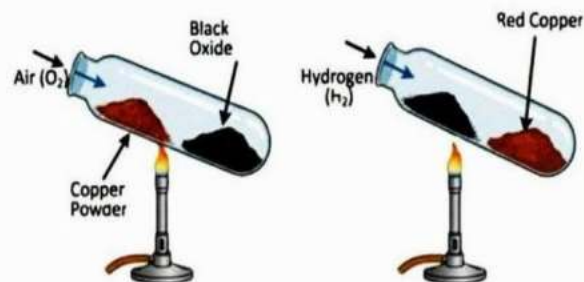
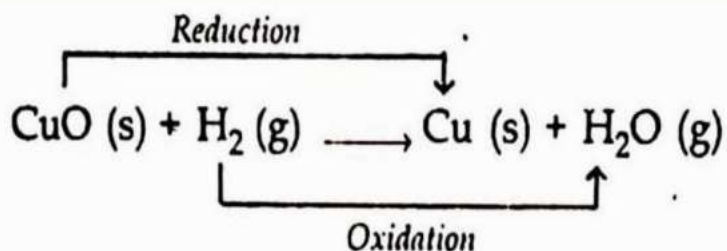
- In this reaction, oxidation of copper occurred because it gained oxygen. Copper in this case is known as the Reducing Agent.

2. Reduction Process:

- A chemical process that leads to a decrease in the percentage of oxygen in a substance or an increase in the percentage of hydrogen in it.

Example: Reduction of Copper Oxide :

- When a stream of hydrogen gas is passed over black copper oxide (CuO) with heating, reddish-brown copper and water vapor are formed.



In this reaction:

- Copper Oxide: Underwent reduction because it lost oxygen. It is known as the Oxidizing Agent.
- Hydrogen Gas: Underwent oxidation because it gained oxygen. It is known as the Reducing Agent.

Oxidizing Agent:

The substance that gives oxygen or takes hydrogen during a chemical reaction (it undergoes the reduction process)

Reducing Agent:

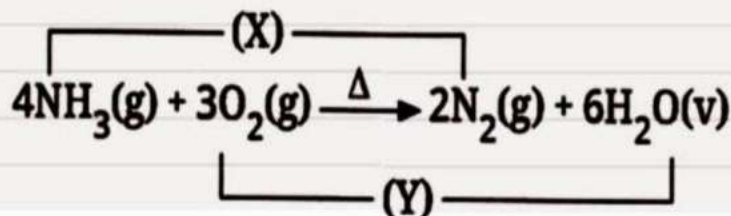
The substance that takes oxygen or gives hydrogen during a chemical reaction (it undergoes the oxidation process)

Technological Application: Food Preservation by Vacuum Packing

- Principle : Removing air provides a low-oxygen environment, which works to reduce oxidation and reduction reactions that lead to food spoilage.
- Result : Extending the shelf life of preserved foods.

"Training: "Assess Your Understanding

- **Ammonia gas burns incompletely in air according to the equation (implied):**



Clarify each of the following : ☐

- The Process (X) occurring to Nitrogen (N): ☐
- The Process (Y) occurring to Oxygen (O): ☐
- The Oxidizing Agent: ☐
- The Reducing Agent: ☐



Unit (2) Lesson One

Newton's Laws of Motion



Physical quantities

Scalar Physical quantities: quantities that are fully defined by magnitude only (Ex. mass, time, distance, speed).

Vector Physical Quantities: quantities that are fully defined by both magnitude and direction (Ex. force, acceleration, velocity, displacement).

G.R: Mass is scalar (magnitude only), while force is vector (magnitude and direction).

Because mass is fully defined by its magnitude only, while force defined by both its magnitude and direction.

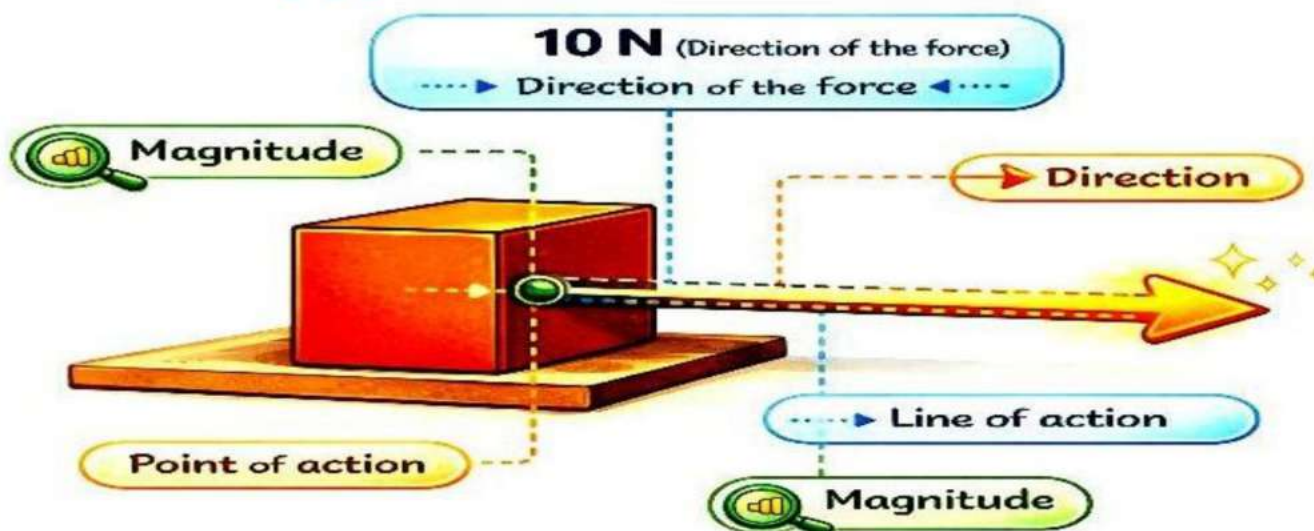
Force is a vector physical quantity that is fully defined by its magnitude and direction.

It is measured in the unit of newton (N) by using a Newton meter device (spring balance).

Force changes or tends to change an object's state of motion.

Force (in kinematics)

is an external agent that changes an object's state of rest or uniform motion.



Force is measured in Newton (N)

The effect of forces on objects:

**The
magnitude of**

Direction

**Point of
action**

**Line of
action of
The force**

**For example
10 N**

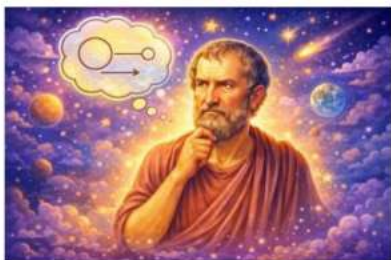
**The line
that
indicates
the
direction of
force's
effect**

**A specific
point on the
object at
which the
force acts**

**Straight line
passing
through the
point of action
of the force
and extends in
both directions
along the
arrow
representing
the direction of
the force**

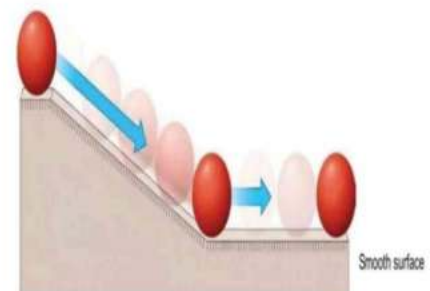
The relationship between force and motion dates back to ancient times ,and these attempts are:

Aristotle 's belief



**Believed that objects
would not continue in
motion unless a force
acted continuously on
them.**

Galileo experiment



**he concluded that objects
to maintain their state of
rest or motion unless acted
upon by an external force.**

The scientist **Isaac Newton**

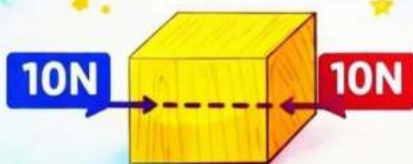
- An English scientist, considered one of the most influential scientists in physics and mathematics over ages, and one of the icons of the scientific revolution.
- He formulated Newton's Laws of Motion and the universal law of gravitation, which dominated scientists' view of the material universe for three centuries until they were refined by the theory of relativity.
- He made important contributions in the field of optics.
- He developed a theory of colours based on his observations when he used a prism to analyze white light into the colours of the visible spectrum.
- He formulated an empirical law of cooling.
- He studied the speed of sound in air.



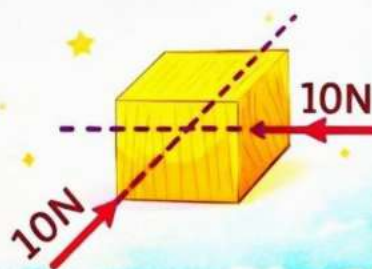
Scientist **Isaac Newton**

When two forces act on the same object, they may:

Act on the same line of action



Not act on the same line of action



- The force is measured by a device called **newton meter (spring balance)** shown in the opposite figure.



Newton meter
a device for measuring force

Concepts related to force

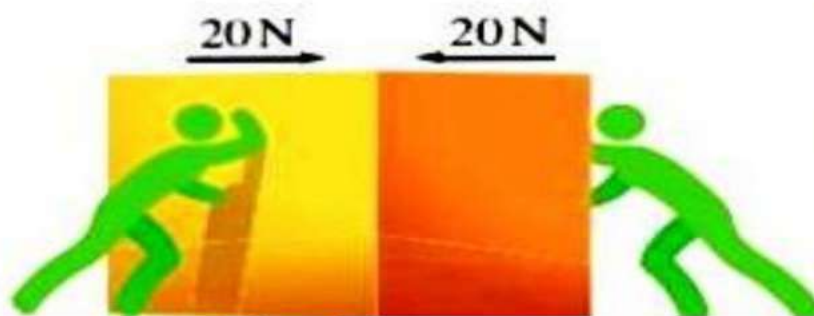
The net force

The total resulting force, when number of forces act on an object.

It determines whether the object will move, stop, or change its speed or direction.

Balanced force

When two forces of equal magnitude act on an object in opposite directions, along the same line of action.



• The net force on the object is the result of their difference which equals zero.

Unbalanced forces

• When several forces act on an object and their resultant is not equal to zero.





1. An object is acted upon by two forces in the same direction along the same line of action .

-The net force in this case is equal to their sum and acts in their common direction.

2. An object is acted upon by two unequal forces in opposite directions along the same line of action.

-The net force in this case is equal to their difference and acts in the direction of the greater force.



Newton's Laws of Motion



Newton's Laws of Motion are the foundation for studying **Kinematics** and are expressed in simple mathematical formulas, which are useful in studying the causes of motion.

Newton established three laws to explain and interpret the motion of objects when acted upon (affected) by one force or a number of forces, these laws are:

Newton's first
law

Newton's second
law

Newton's third
law

Newton's First Law



- **Newton's first law** clarifies that the resultant of the forces acting on object is the reason for changing its state of rest or motion, as shown in the following:

When a box is placed on the top of a stationary car

- It remains **stationary** (at rest) unless acted upon by an external unbalanced forces that change its state of rest.



- It moves at the **same velocity** of the car, for an observer (person) standing on the sidewalk.
- When the car **stops suddenly**, the box moves forward, keeping its state of motion for a certain period of time, unless **acted upon by external unbalanced forces** that change its state of motion.



When a box is placed on the top of a moving car

- It moves at the **same velocity** of the car, for an observer (person) standing on the sidewalk.
- When the car **stops suddenly**, the box **moves forward**, keeping its state of motion for a certain period of time, unless acted upon by **external unbalanced forces** that change its state of motion.



i.e: An object tends to keep its **state of rest or motion** for a certain period of time unless acted upon by **external unbalanced forces** that change its kinematic state, which is known as the **inertia of objects (law of inertia)**.



Newton's First Law (Law of Inertia)



The object keeps its state of rest or motion at a constant velocity in a straight line, unless acted upon by **external unbalanced forces** that change its state.

Examples of daily observations of inertia

1 Rushing the bus passengers forward when the bus stops suddenly... **G.R.?**

Because the inertia of the passengers causes them to resist the sudden change that occurs in their state of motion when the brakes are applied trying to keep the state of motion they were in.



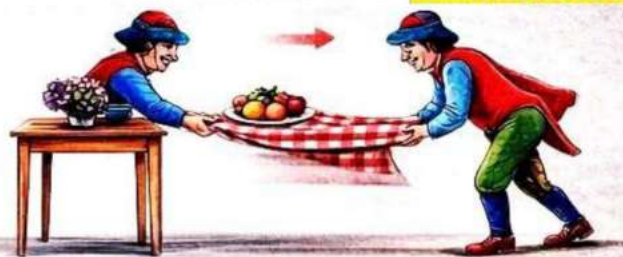
2 Rushing a stationary bus passengers backward when it moves suddenly... **G.R.?**

Because the inertia of the passengers causes them to resist the sudden movement of the bus, trying to keep the state of rest, so they move backward.



Q2 What happens when a tablecloth is quickly pulled from under a fruit plate placed on a table? Explain.

A The plate remains in its place, because the **inertia of the plate** causes it to resist the sudden movement of the tablecloth, to keep its state of rest.

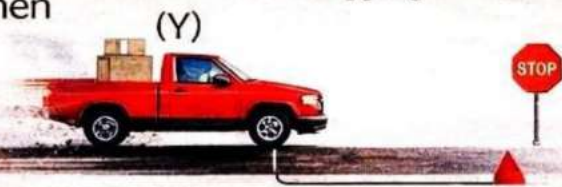


► The effect of the object's mass on its inertia

- The inertia of stationary or moving object depends on **its mass**, so as the mass of the object **increases**, its **inertia increases**, **i.e.**
- It is difficult for the object to move when it is at rest.
- It is difficult for the object to stop when it is moving, this is indicated by the increased time of keeping its state of motion, which causes the stopping time and retrates



Stopping distance



Stopping distance



Stopping distance of the car (Y) ➔ Stopping distance of the car (X)

Stopping time
The time taken for the moving object to stop.



Stopping distance (X)
The distance travelled by the moving object during the stopping time.



✓ Application

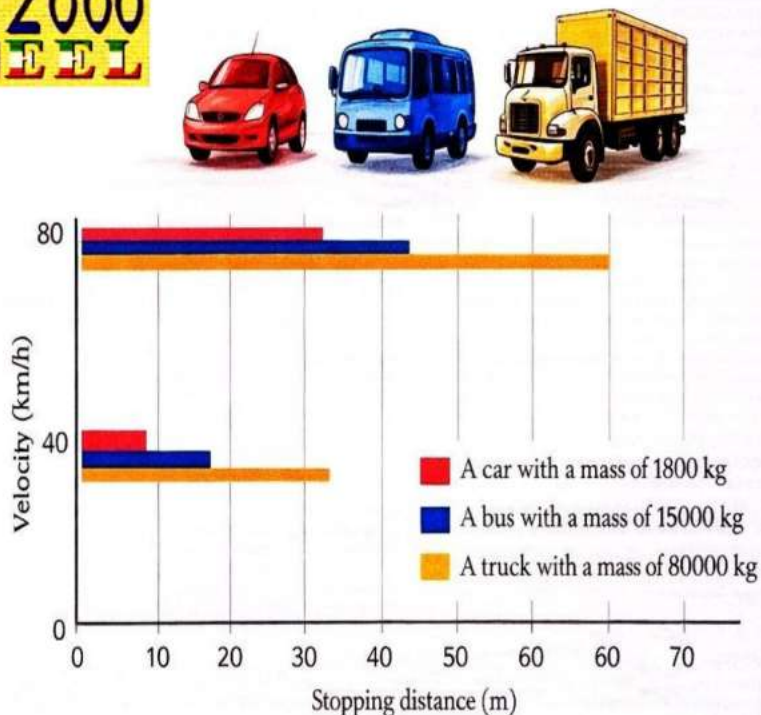


• In the opposite graph:

- The vertical axis represents the velocity of three vehicles (they have the same velocity in each case).
- The horizontal axis represents the stopping distance of each of the three vehicles in each case.

From the data in the graph, it is clear that:

The stopping distances of the three vehicles are **directly proportional** to their masses.



The car



The bus



The truck



i.e. The greater the mass of a moving object, the greater its inertia.

⚙ Technological applications

1 Cruise control:

A device used to keep the velocity of the cars constant on highways without any direct driver intervention, through using sensors.

The idea of its working:

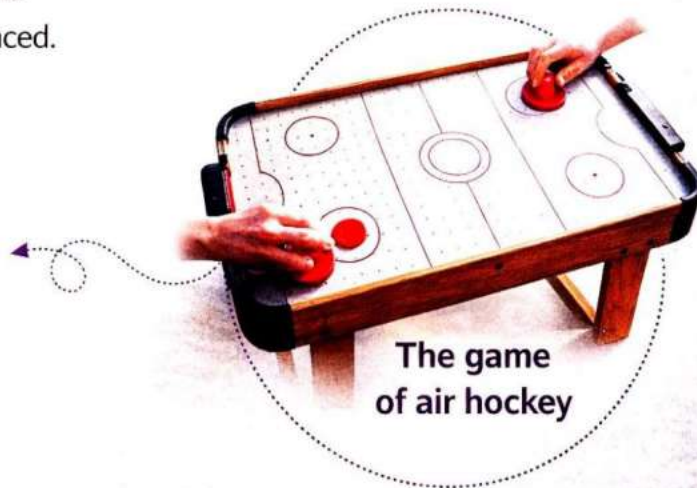
The sensors control pumping the fuel at a rate that makes the forces acting on the car balanced.



Cruise control

2 Air hockey:

A fun game in which two round paddles are used to push a light disc that slides on a smooth table with holes.

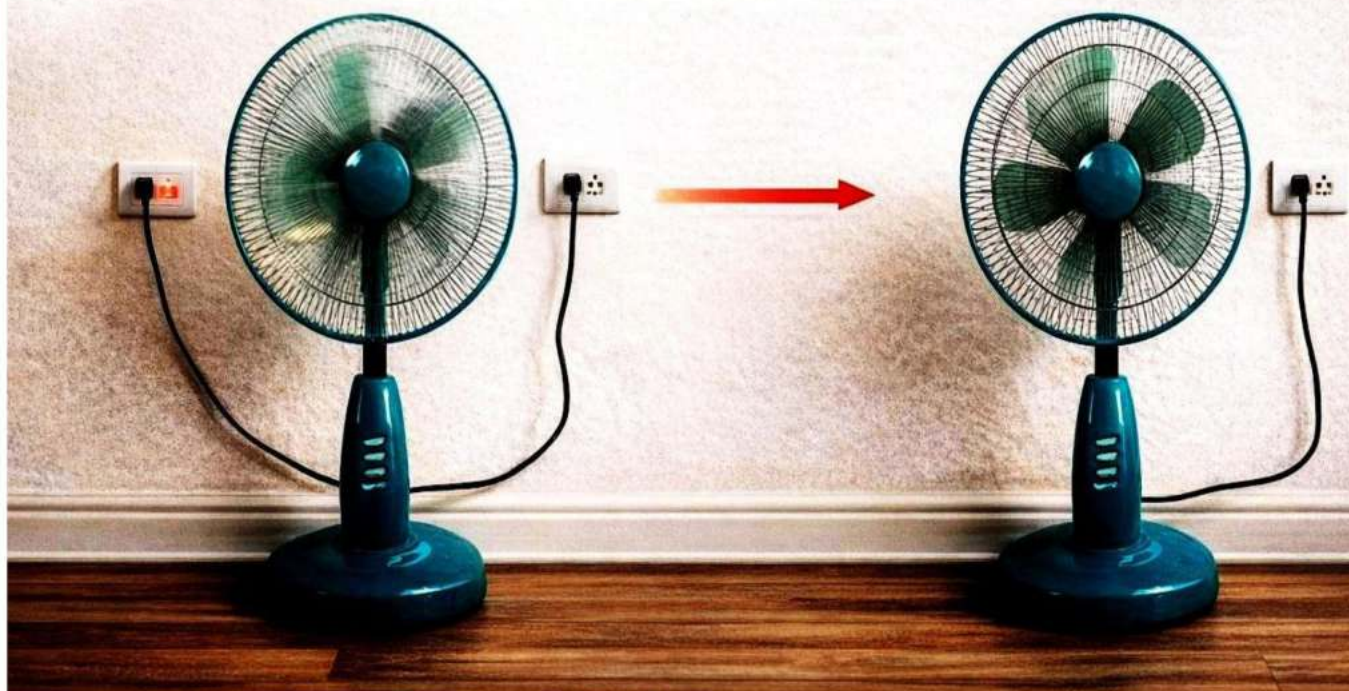


The game of air hockey



Q1 What happens when the electric current flowing to a fan is switched off while it is moving? Explain.

A The fan blades continue to rotate for a few seconds after the electric current is switched off, because the inertia of the fan blades causes them to resist the sudden stop that occurs after the electric current is switched off, to keep the state of motion they were in.



Newton's second law

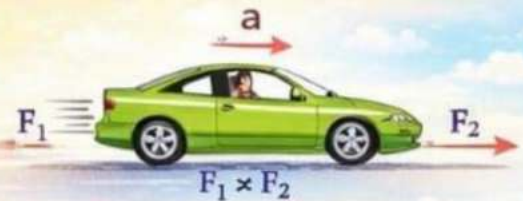


Newton's second law explains the effect of the net force on changing the velocity of the object over time, as shown below:

If unbalanced forces whose resultant (net force) does not equal zero act

Its velocity changes (increases or decreases) during its motion

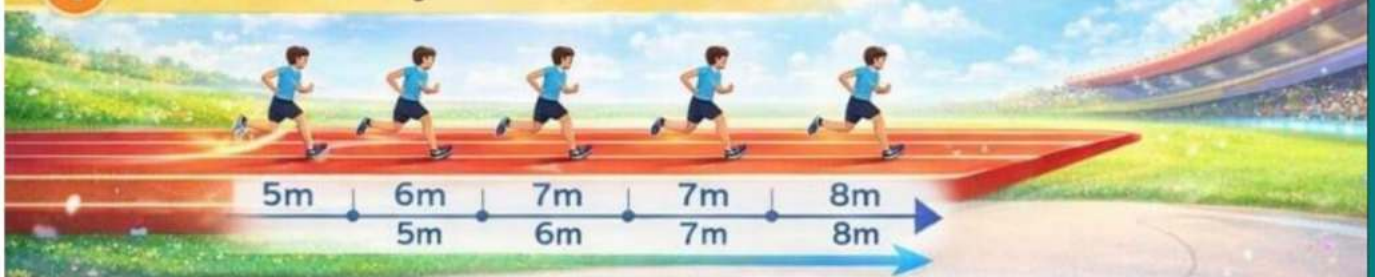
Then this object is described as moving with an acceleration (a)



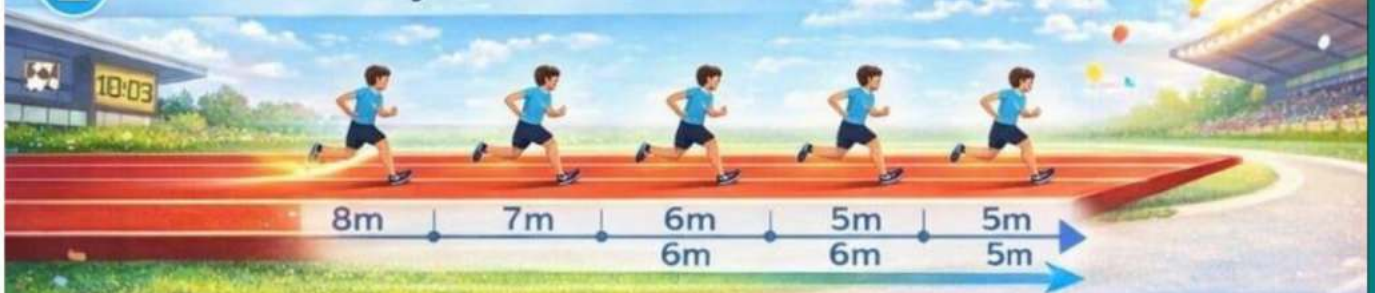
The concept of acceleration

- The object is described as moving with acceleration in the following three:

1 When its velocity increases over time.



2 When its velocity decreases over time.



3 When the direction of its motion changes (even if it is moving at constant velocity).



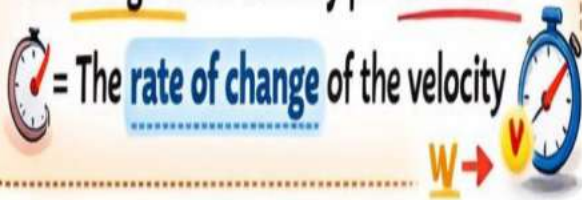
Newton's Second Law of Motion

Acceleration is in the Same Direction as the **Net Force**!

Acceleration (a)

The change in the velocity per unit time

= The **rate of change** of the velocity



Newton's Second Law

If a **Net Force (F)** acts on an object of mass (**m**), it causes



Acceleration (a) in the same direction

as the net force.

Formula:

$$F_{net} = m \times a$$

Net Force (N)

Mass (kg)

Acceleration (m/s^2)

Units of Measurement

Force (F) → Newton (N)

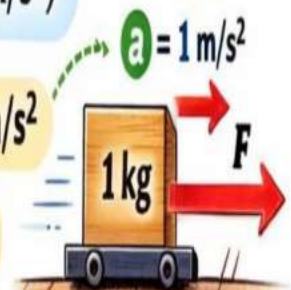
Mass (m) → Kilogram (kg)

Acceleration (a) → $N/kg = m/s^2$

Example: If $m = 1 \text{ kg}$ and $a = 1 \text{ m/s}^2$

Then, $F = 1 \times 1 = 1 \text{ N}$

→ Net force of **1 Newton (N)**

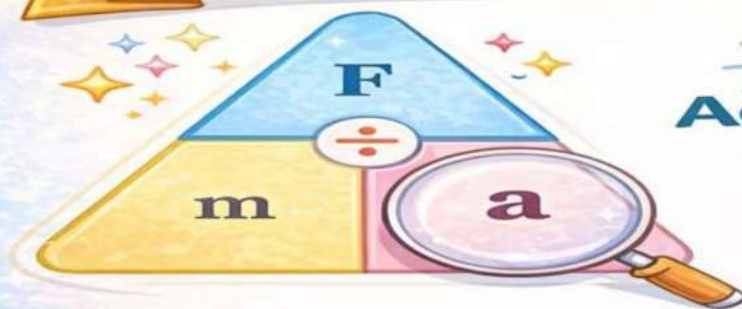


Meaning of $1 \text{ N} = 1 \text{ kg} \cdot \text{m/s}^2$?

An object with a mass of **1 kg** accelerating at 1 m/s^2 is affected by a net force of **1 N** in the **same direction** of motion.



How to Calculate the Acceleration



To calculate
Acceleration

$$a = \frac{F}{m}$$

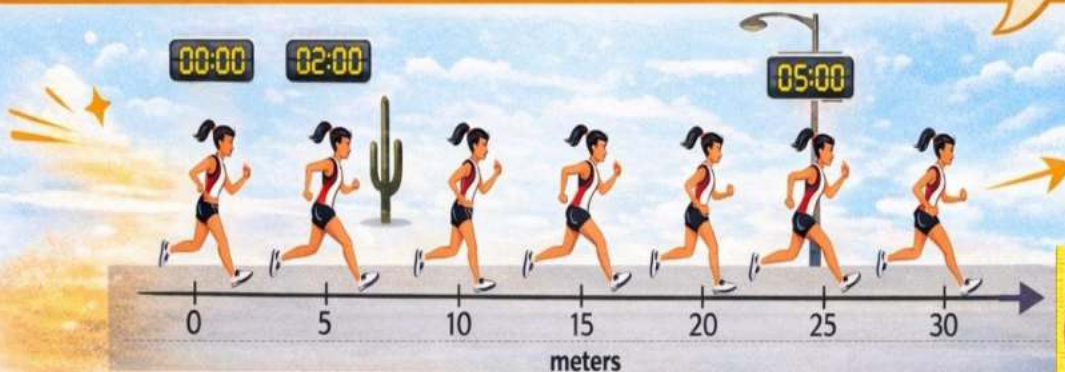
How to Calculate the Force



$$F = m \times a$$

Does the runner move in the following figure with **constant velocity** or with **acceleration**?

Explain why.



Time Interval (s)	Time (s)	Distance (m)	Average Velocity = $\frac{\text{Distance}}{\text{Time}}$
0–2	2	5	$\frac{5}{2} = 2.5 \text{ m/s}$
2–5	3	20	$\frac{20}{3} = 6.7 \text{ m/s}^2$

Speed increases over time. ↗

The runner moves with **acceleration**. ⚡

!Answer!





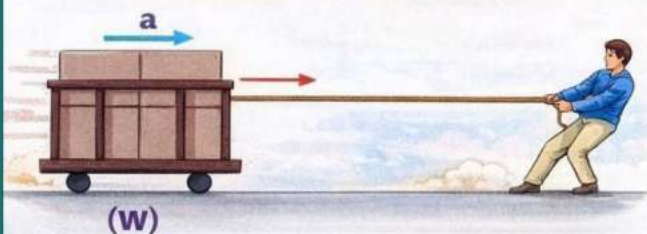
Factors Affecting Acceleration



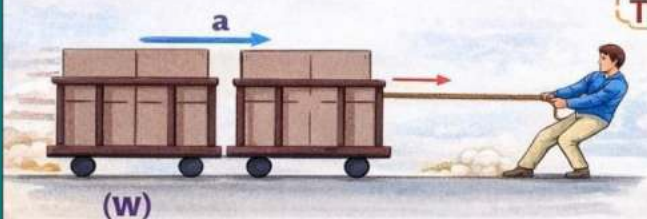
1

Mass of the object

If two **equal** forces act on two objects (W & X) **different** in mass



(W)



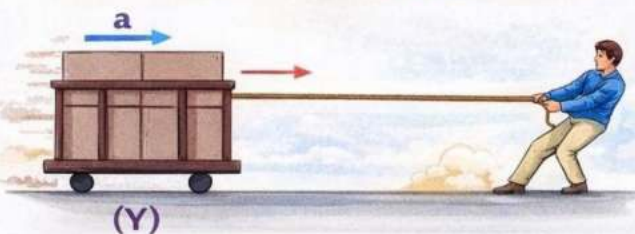
(W)

► The object (X) with **greater mass** moves with **less** acceleration

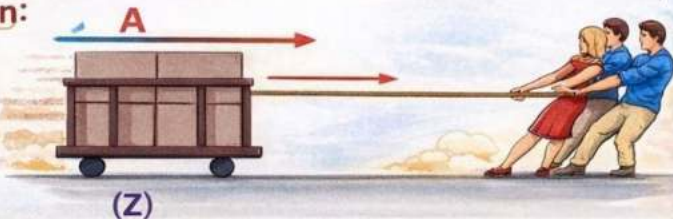
2

The Net Force Acting on the Object

If two **different** net forces act on two objects (Y & Z) **equal** in mass



(Y)



(Z)

► The object (Z) which is affected by a **greater net force** moves with **greater acceleration**



The Relationship Between Acceleration, Mass, and Force

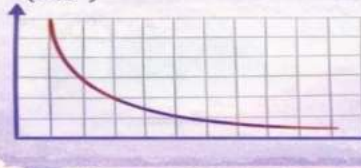


1

The Acceleration (a) and Mass (m) of the object at constant Net Force (F)

$$a \propto \frac{1}{m}$$

Acceleration (a)
(m/s²)



Mass (m)
(kg)

When the **mass** of the object **increases**,
Acceleration **decreases**

2

The Acceleration (a) and Net Force (F) on the object at constant Mass (m)

$$a \propto \frac{F}{m}$$

Acceleration (a)
(m/s²)



Net Force (F)
(N)

When the **net force** on the object **increases**,
Acceleration **increases**

Therefore:



What Happens to the Acceleration?

Application

If the net force is doubled:

$$F_2 = 2 F_1$$

$$m_1 = m_2$$

The acceleration increases to **double!**

$$a_2 = 2 a_1$$

In the First Case:

$$F_1 = 1000 \text{ N}$$

$$m_1 = 1000 \text{ kg}$$

$$a_1 = \frac{1000}{1000} = 1 \text{ m/s}^2$$

Doubled →

In the Second Case:

$$F_2 = 2000 \text{ N}$$

$$m_2 = 1000 \text{ kg}$$

$$a_2 = \frac{2000}{1000} = 2 \text{ m/s}^2$$

Doubled



2 If the mass of the object is **doubled** while the net force acting on it remains constant:



$$m_2 = 2m_1$$

$$F_2 = F_1$$

The acceleration decreases to half:

$$a_2 = \frac{1}{2}a_1$$

In the first case

$$F_1 = 1000 \text{ N}$$

$$m_1 = 1000 \text{ kg}$$



$$a_1 = 1 \text{ m/s}^2$$

In the second case

$$F_2 = 1000 \text{ N}$$

$$m_2 = 2000 \text{ kg}$$



$$a_2 = \frac{1}{2} \text{ m/s}^2$$

3 If the net force acting on an object is **doubled** and its mass is **decreased to half**:



$$F_2 = 2F_1$$

$$m_2 = \frac{1}{2}m_1$$

The acceleration increases to **4 times** its value:

$$a_2 = 4a_1$$

In the first case

$$F_1 = 1000 \text{ N}$$

$$m_1 = 1000 \text{ kg}$$



$$a_1 = 1 \text{ m/s}^2$$

In the second case

$$F_2 = 2000 \text{ N}$$

$$m_2 = 500 \text{ kg}$$



$$a_2 = 4 \text{ m/s}^2$$



! Safety precautions

When a car stops suddenly for any reason, the driver collides with the steering wheel or the windshield, according to Newton's first law (law of inertia), so to protect the driver from rushing forward, it is necessary to consider some safety precautions **such as:**

1

Fastening the seat belt



2

The presence of the airbags



Importance

The seat belt works to reduce the rushing forward of the driver towards the steering wheel or the windshield during sudden stopping

The air bag works with the seat belt to prolong (increase) the collision time and thus reducing the rate of change of the velocity (acceleration) which in turn minimizes the impact of the collision on the driver

Newton's Third Law

- When a person jumps from the front of a boat forward, the boat itself moves backward as **shown** in the figure, this phenomenon is explained by **Newton's Third Law**.



Activity Practical

Tools used:

- Balloon
- Fishing line.
- Juice straw.
- Binder clip (clothes clip).
- Adhesive tape.

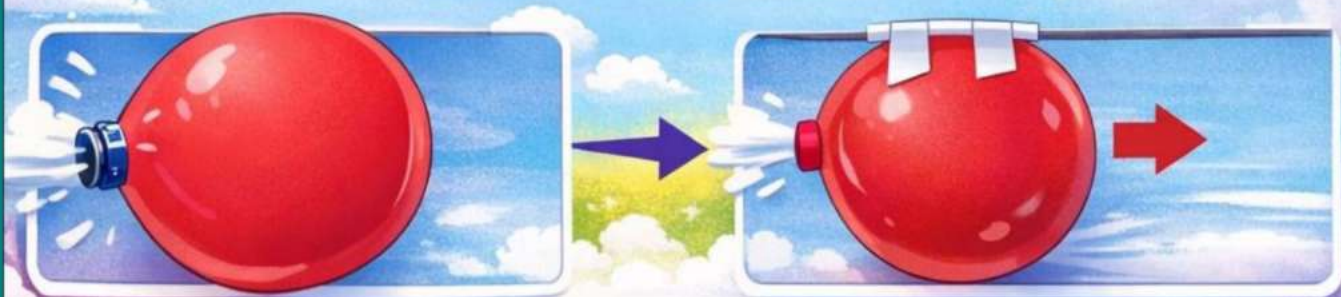
Steps :

- Fix one end of the fishing line to the door handle.
- Pass the free end of the line through the juice straw.
- Stretch the line and fix its free end to a rigid object.
- Attach the balloon with adhesive tape to the juice straw, then remove the clip.



Explanation :

The balloon moves in the opposite direction of the air rushing out of it.



They occur simultaneously!

Rushing of air out of the balloon
(expressed by the arrow)

Direction of the action
(Thrust of the air out)

Rushing of the balloon in the opposite direction
(expressed by the arrow)



Conclusion:

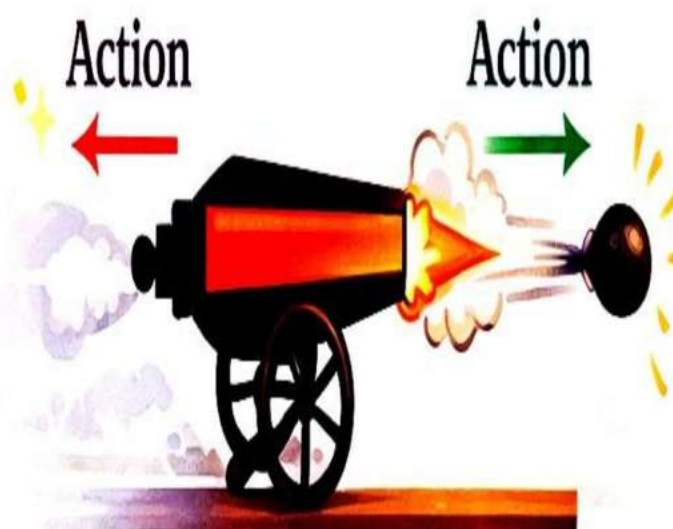


Action and reaction always occur without any time difference in two opposite directions on two different objects.

★ Newton's Third Law: can be defined as follows: ★

Newton's Third Law:

For every action, there is an equal and opposite reaction.



When the shell is propelled forward, the cannon moves backward.



When Equal Forces Act...

◆ Case 1: On **ONE** object

They cancel out! ➔

(Newton's First Law)

🐾 Example: Cat on a Table

Gravity pulls the cat
down

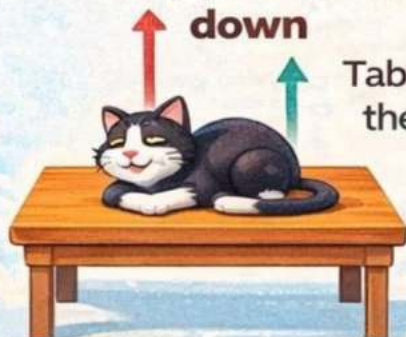


Table pushes
the **cat up**

Same strength, opposite directions

Result: The cat stays still and comfy 😊

WHY?

Balanced forces on the **same object** cancel each other ➔ no motion change.

🚀 Case 2: On **TWO** different

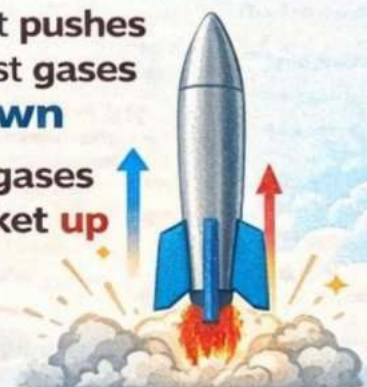
They do NOT cancel out! ➔

(Newton's Third Law)

🐾 Example: Rocket Launch

Rocket pushes
exhaust gases
down

Exhaust gases
push rocket **up**



Equal forces, opposite directions

Result: The rocket blasts off! 🔥

WHY?

Action-reaction forces act on **different objects**, so they don't cancel.



Quick Rule to Remember

◆ **Same object** ➔ forces cancel ➔ **First Law**

◆ **Different objects** ➔ forces pair up ➔ **Third Law**





1 Describe the direction of movement of each girl after the feet push off, with explanation.

2 What is the law which explains what happened?

1 The two girls move in **opposite directions**, because action and **reaction** always act in opposite directions without any time difference.

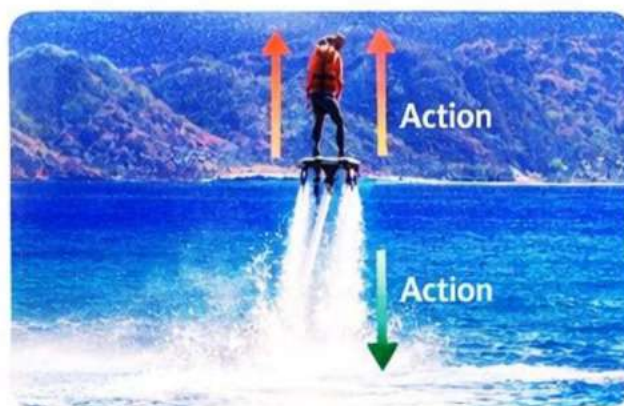


Life application:

The flying water board (Flyboard)

The idea of its operation:

It operates by pumping water strongly downward through the board nozzles strongly (action), allowing the user to fly upward in the air (reaction).



Flyboard



Technological application:

Unmanned aerial vehicles (Drones)

The idea of its operation:

It works by pushing air downwards from the engines (action), resulting in pushing the drone upwards (reaction) with an equal force.



Drone

Summary of Newton's Laws of Motion

Newton's First Law

An object at **rest** stays at rest, and an object in motion stays in motion unless acted upon by an **unbalanced force**



Unbalanced force changes an object's **kinematic** state of rest or motion

Law of Inertia

Newton's Second Law

$$\text{Force} = \text{Mass} \times \text{Acceleration}$$



More force, more acceleration!

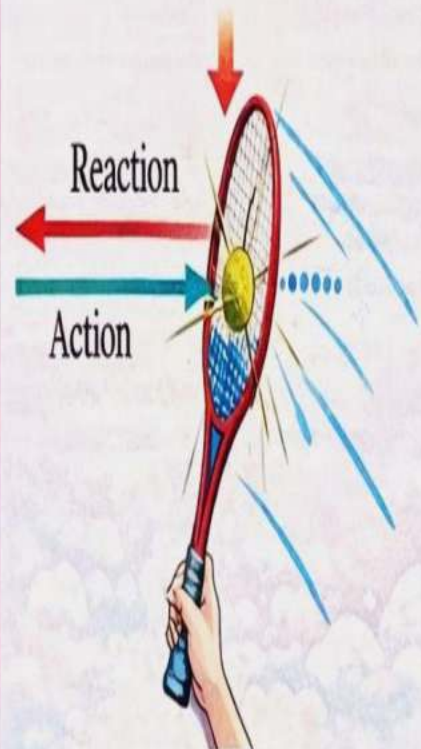


More force,
more acceleration!

Law of Acceleration

Newton's Third Law

For every **action**, there is an **equal and opposite reaction**



Equal forces in
opposite directions

Law of Action-Reaction

The effect of collisions on changing velocity



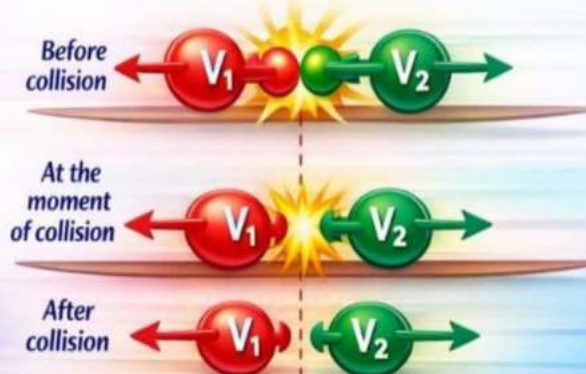
• If a collision occurs between two moving objects •

Having the **same mass**, and the **same velocity**, but in **opposite** directions
(assuming no energy loss)

Then

Both objects move in the **opposite (reverse)** direction at the **same velocity** at the same velocity as they gain acceleration, as a result of the change in direction.

- The direction of the acceleration is the same direction of the affecting force.

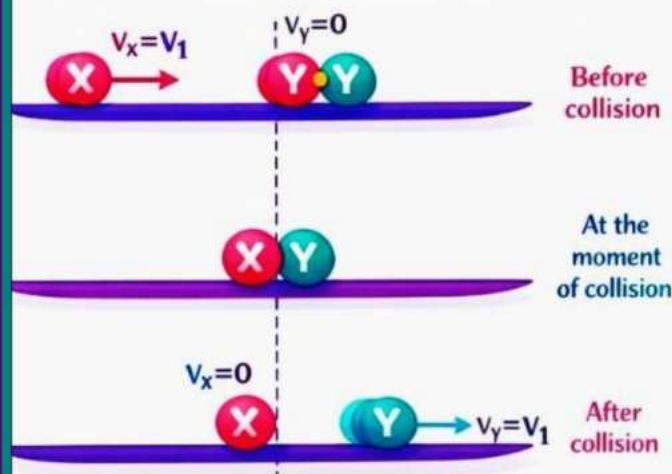


• If a collision occurs between a **moving object** and **stationary object** •

Having the **same mass**, so they are affected by two forces equal in magnitude but **opposite** in direction, and a number of possibilities are expected.

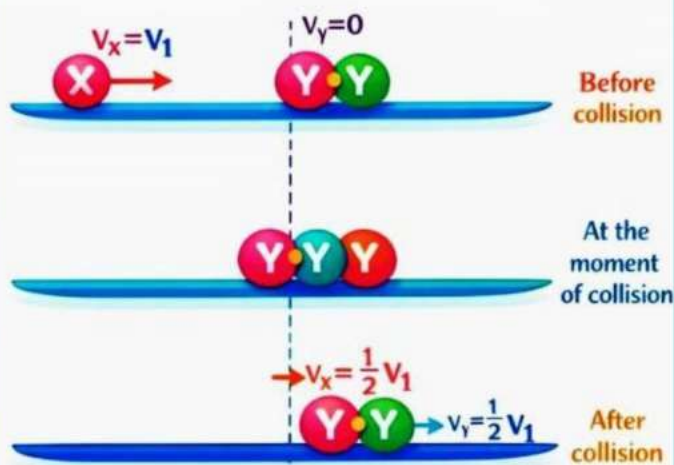
Elastic collision

Leads to the **stopping (the rest)** of the moving object, and **the movement** of the stationary object **at the same velocity** of the moving object before collision



Inelastic collision

Leads to the **slowing down (decrease in velocity)** of the moving object, with the movement of the stationary object, and both of them move **together** after collision **at half the velocity** of the moving object before collision



Levers

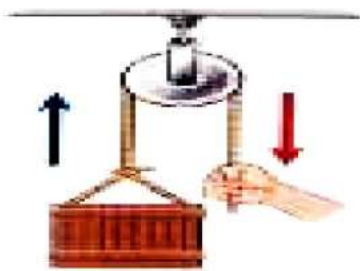
Machines are tools used by humans to save time, effort, or both while performing work.

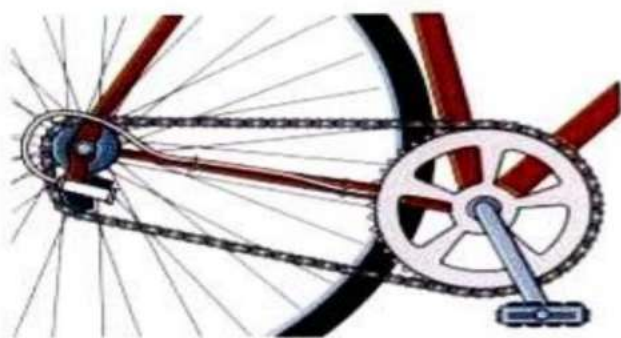
Example:

The tower crane (winch):

Used to lift concrete blocks in the construction of massive buildings, is an example of complex machines that consist of many simple machines.



Machines	Shape of machines	Usage
Bottle opener		Change the direction of effective force
Pulley		Change the direction of force when lifting a load

Inclined plane (Ramp)		The ramp is used to save effort
Wheel and Axle		Multiply force or increase speed.
The wedge		The wedge changes the direction of the applied force
Claw hammer		Multiplies force when removing a nail from a wooden board
Gears and belts		Gears and belts transfer motion and change speed as in bicycles

Tweezers



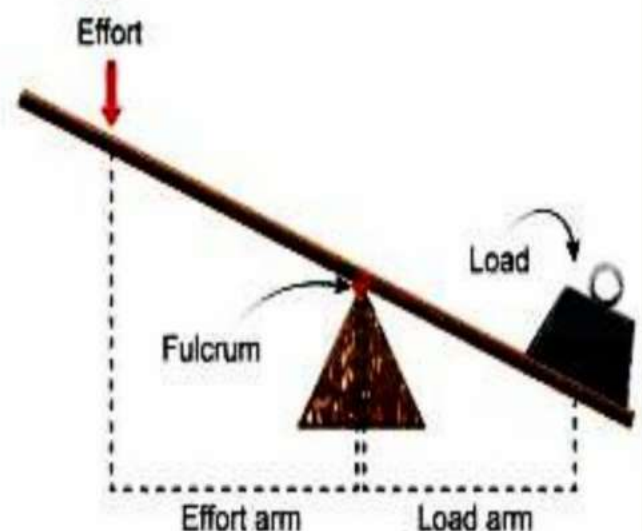
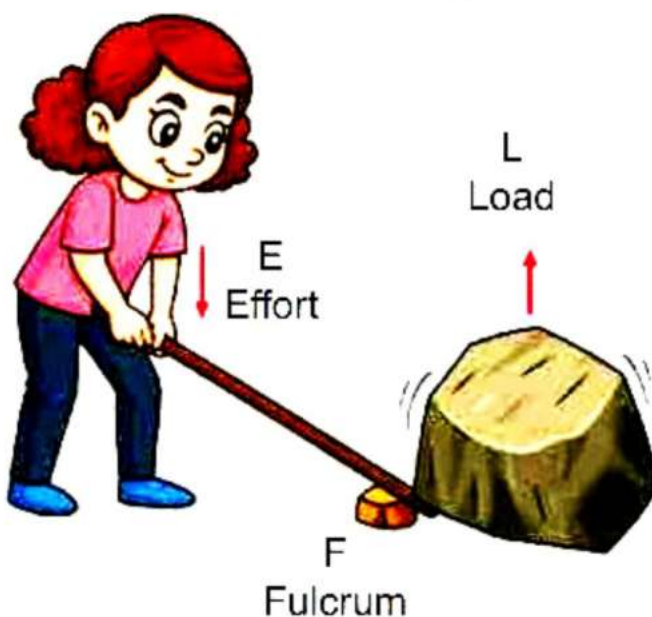
Tweezers are used in precise work.

Barbecue tongs



are used to avoid the risk of burning.

Lever : is a rigid rod, either straight or curved, that is pivoted on (can move around) a fixed point called the **fulcrum (F)** and is affected by two forces act upon it; the **effort (E)** and the **resistance or the load (L)**.



Levers components



Force (effort): is the force that moves the weight (resistance).

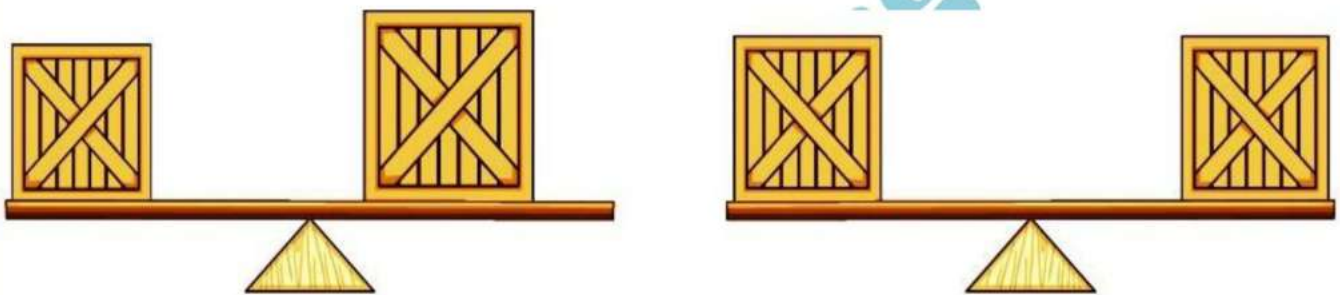
Fulcrum: is the point which the lever rotates.

Resistance: is the weight that moves under the effect of force.

Load arm: is The distance between the load and the fulcrum.

Effort arm: is the distance between the applied force (effort) and the fulcrum.

The lever is at equilibrium when the product of the Effort and its arm equals the product of load and its arm.

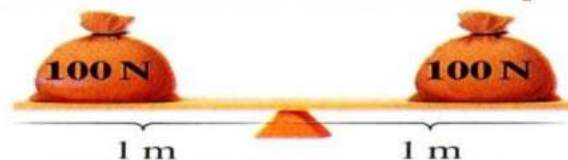


Balanced levers

The product of the effort and its arm is called **moment of effort**.

The product of the load and its arm is called **moment of Load**.

The lever is balanced when the moment of effort equals the moment of load.



$$100 \times 1 = 100 \times 1$$

Balanced lever



$$100 \times 1 = 50 \times 2$$

Balanced lever

Law of Levers

$$\text{Effort} \times \text{Effort Arm} = \text{Load} \times \text{Load Arm}$$

"Moment of Effort" "Moment of Load"

$$\text{Mechanical Advantage of Lever} = \frac{\text{Load}}{\text{Effort}} = \frac{\text{Length of Effort Arm}}{\text{Length of Load Arm}}$$

Cross - cutting concepts : Cause and Effect

Increasing the length of the effort arm (cause), leads to

- In a lever, a load of mass 2 kg is suspended at 15 cm to the right of the fulcrum. To balance the lever horizontally, another load of weight 30 N that represents the resistance is suspended at a distance (x) cm to the left of the fulcrum.

[Gravitational acceleration = 10 m/s^2]

Calculate:

- (1) The value of (x).
- (2) The mechanical advantage of this lever.

Solution:

$$\begin{aligned}\text{Weight of load (force)} &= \text{mass} \times \text{acceleration due to gravity} \\ &= 10 \times 2 = 20 \text{ N}\end{aligned}$$

- (1) $\therefore \text{Effort} \times \text{its arm} = \text{Load} \times \text{its arm}$

$$20 \times 15 = 30 \times (x)$$

$$\therefore \text{Load arm (x)} = \frac{20 \times 15}{30} = 10 \text{ cm}$$

- (2) $\therefore \text{Mechanical Advantage of Lever} = \frac{\text{Magnitude of Load}}{\text{Magnitude of force}}$

$$\therefore \text{Mechanical Advantage} = \frac{30}{20} = 1.5$$

- The weight of a body is the force of Earth's gravity acting on it

$$\text{Weight (w)} = \text{Mass (m)} \times \text{Acceleration due to gravity (g)}$$



Types of Levers

First-Class Lever

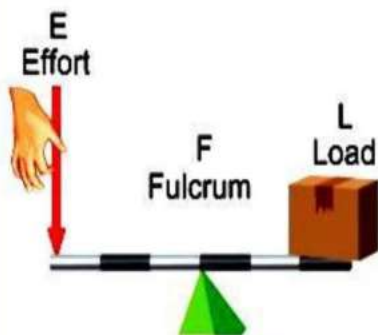


Figure (21)
Example

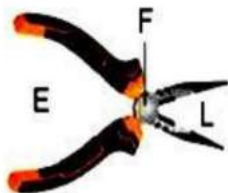


Figure (22) Pliers

Second-Class Lever

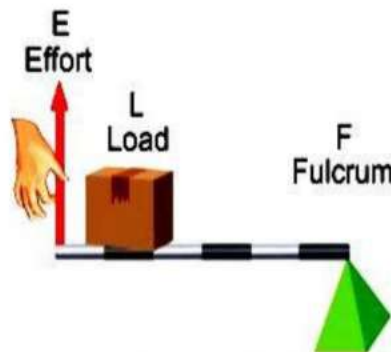


Figure (23)
Example



Figure (24) Lemon squeezer

Third-Class Lever

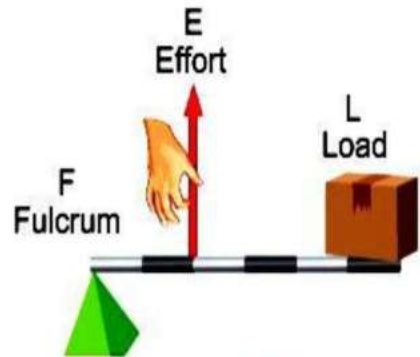


Figure (25)
Example



Figure (26) Tweezers

The fulcrum is located between the effort and the load.

Examples : Seesaw, Crowbar, Scissors, and Pliers.

All first-class levers change direction of force, but some save effort and others do not.

The load is located between the fulcrum and the effort.

Examples : Wheelbarrow, Nutcracker, and Lemon Squeezer

All second-class levers save effort, because the effort arm is always longer than the load arm.

The effort is located between the fulcrum and the load.

Examples : Tennis Racket, Hand Broom, Tweezers (Forceps), and Coal Tongs.

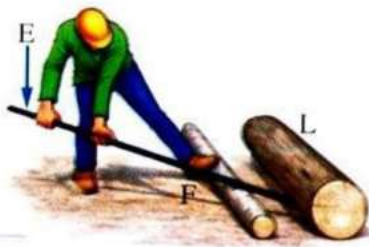
All third-class levers never save effort but they are used in precise and dangerous tasks.

Examples

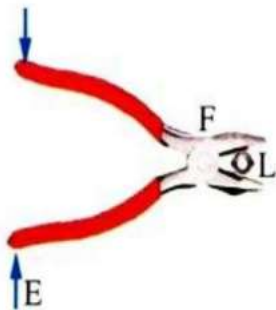
1. Seesaw.



2. Crowbar.



3. Pliers.



4. Scissors.

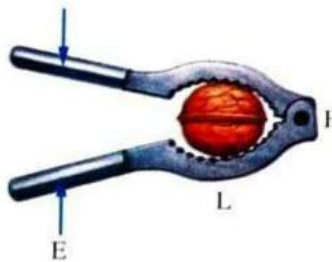


Examples

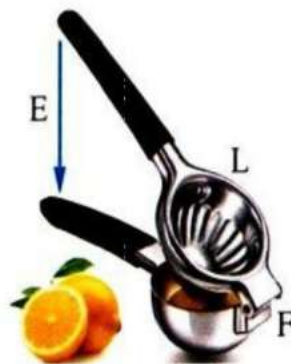
1. Wheelbarrow.



2. Nutcracker.



3. Lemon squeezer.



4. Bottle opener.

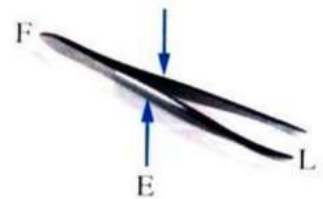


Examples

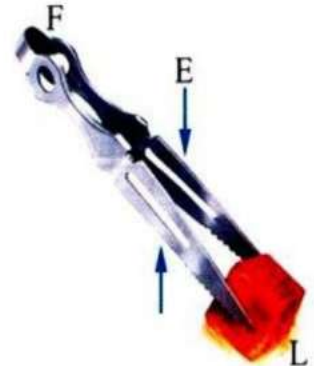
1. Tennis racket.



2. Tweezers (Forceps).



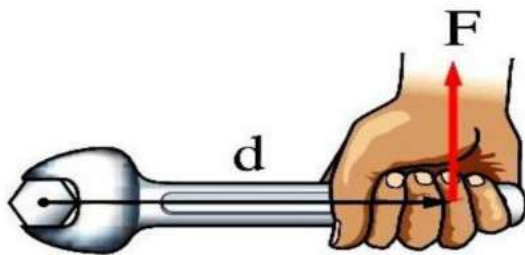
3. Coal tongs.



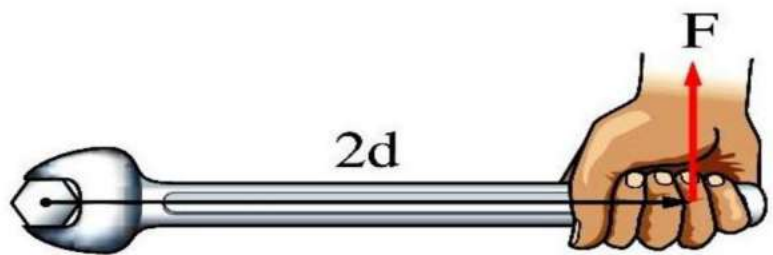
4. Broom.



Which of the 2 cases save more effort? Explain your answer.



Case (1)



Case (2)

Case (2), because effort arm in case (2) is double the effort arm in case (1) and as the effort arm increase, the required effort decrease and the mechanical advantages increases (the machine save more effort).

Levers with mechanical advantage

Greater than 1 save effort		Equal to 1 Do not save effort	Less than 1 Do not save effort	
As in		As in	As in	
All second class levers	Some first class levers	Some first class levers	Some first class levers	All third class levers
Effort arm > Load arm		Effort arm = Load arm	Effort arm < Load arm	
Effort < Load		Effort = Load	Effort > Load	
Example		Example	Example	
Nutcracker	Pliers	Seesaw	Scissors	Coal tongs

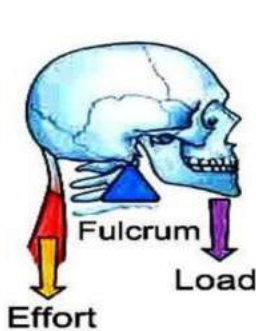
The mechanical advantage of levers may be (1, greater than 1 or less than 1).

★ **Bones forming the skeletal system are levers.**

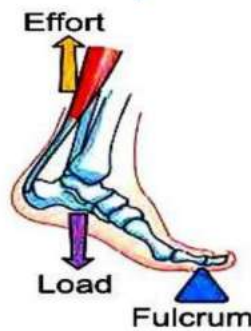
★ **The joints around which bones move represent fulcrums.**

★ **The contraction force of muscles represents the effort.**

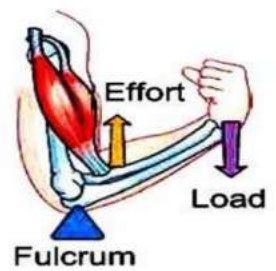
★ **The forces to be overcome represent the resistance (load)**



The Head



The Foot while standing on tiptoes



The Forearm

Types of Levers in the Human Body

The head		The foot (when standing on the tiptoes)	The arm
First class lever		Second class lever	Third class lever
Type	Fulcrum (F)	Load (L)	Effort (E)
Fulcrum (F)	Point of connection of the skull with the spine	Foot while standing on the tiptoes	Forearm (elbow joint)
Load (L)	The weight of the head which needs to be balanced forward	Body weight	The object held in the palm
Effort (E)	The neck muscles that pull the head downwards to be balanced	The calf muscles	The pull of the biceps muscle

Unit (3) Lesson One

Cell division

All living organisms share common characteristics such as:

Nutrition, respiration, sensation, movement, and reproduction

Reproduction

Is a vital biological process through which a living organism produces new individuals of the same species.

Importance of reproduction

Ensuring the continuity of life and protecting the species from extinction.

Cell

Cell is the basic unit of structure and function in all living organisms.

Cells in living organisms are classified into two main types:

- 1-Somatic cells.**
- 2-Reproductive cells.**



1-Somatic cells

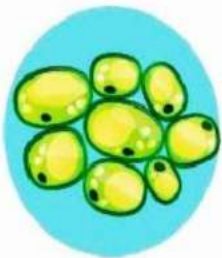


They are all the cells of the organism except the **reproductive cells**.

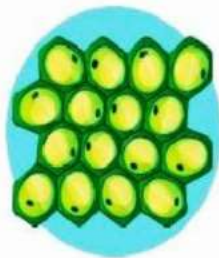
Examples:

★ **Parenchyma and collenchyma cells found in the stems, leaves of plants.**

★ **Intestinal cells and cardiac (heart) muscle cells in animals**



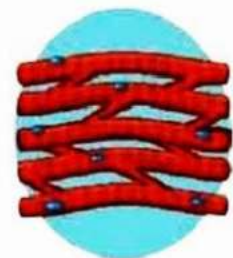
Parenchymal cells



Collenchymal cells



Intestinal cells



cardiac (heart) muscle cells

Note:-

Somatic cells contain the full number of chromosomes in homologous pairs, represented by the symbol $(2n)$.

Within a single species,

The number of chromosome in somatic cells is always the same in the individuals of the same species.

Having the same number of chromosomes in somatic cells of different species does not mean that they are genetically similar.

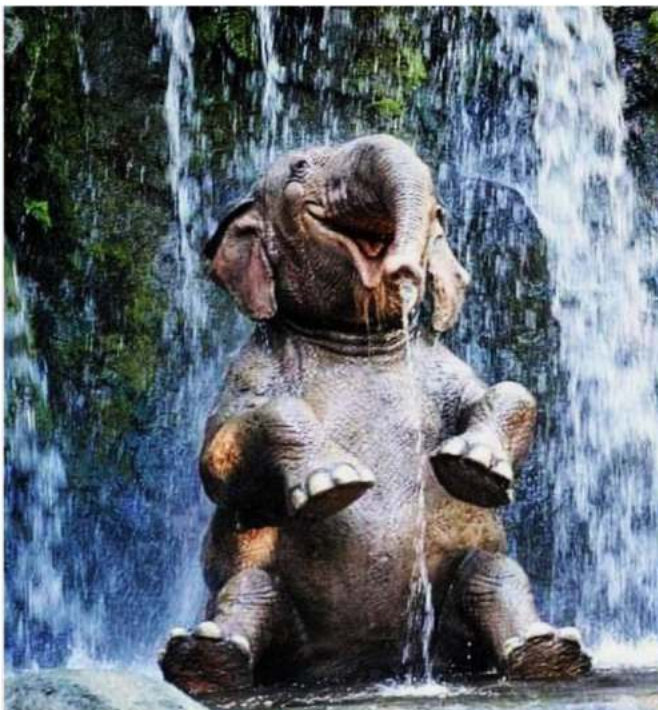


A chimpanzee and a potato plant both have 48 chromosomes (24 pairs), but their genetic information is entirely different.



The chromosome count in cells does not determine the organism size:

An elephant has (56 chromosomes) (larger in size) than crow has 80 chromosomes (smaller in size).

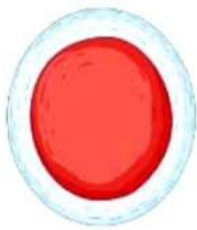


2-Reproductive cells:

Gonads (male and female reproductive organs) produce reproductive cells known as gametes.

Gametes: are the specialized cells responsible for sexual reproduction in living organisms, contain **half the number of chromosomes** found in somatic cells.

The Living Organism	Gonads	Gametes
Animal and human	Testes	Sperms
	Ovary	Ova
Plant	Anther	Pollen grains
	Ovary	Ovules



Ovum
(Female gamete)



Sperm
(Male gamete)



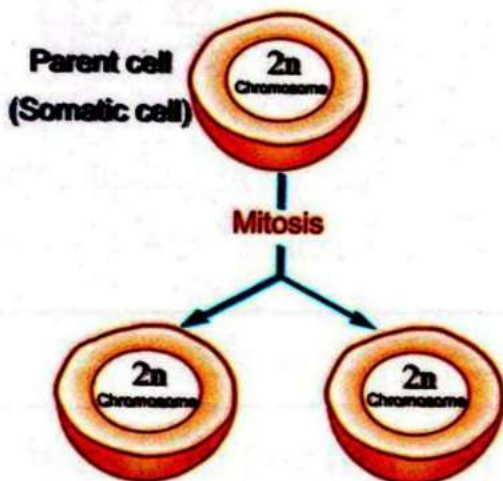
Ovule
(Female gamete)



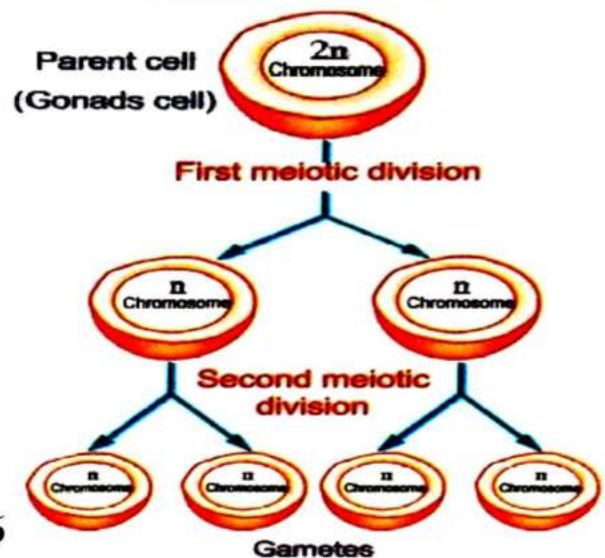
Pollen grain
(Male gamete)

Types of cell division:

1- Mitosis



2- Meiosis



Mitosis Equational division	Meiosis Reductional division
Where it occurs? It occurs in the somatic cells. How it occurs: (Equational division). (why?) Because each diploid somatic cell (2n) divides into two new diploid daughter cells (2n) identical to the parent cell. The number of daughter cells resulting from the division of a single cell: (Two identical somatic cells) The number of chromosomes in each of the daughter cells: The complete number of chromosomes (2n) in the parent cell The genetic information of the daughter cells Each cell resulting from mitosis receives a complete and identical set of the genetic information of the parent cell.	: Where it occurs?: It occurs in the gonad cells. How it occurs: Reductional division. (why?) Because Each gonad cell divides in two stages, which are: First meiotic division (Meiosis I): The diploid parent cell (2n) divides into two haploid cells (n) each containing half the original number of chromosomes. Second meiotic division (Meiosis II): (which is similar to mitosis) each cell (n) resulting from meiosis (I) divides into two haploid cells (n). Hence, four haploid daughter cells (n) are produced, each containing half the original number of chromosomes, and each cell develops into: Sperm or Ovum or Pollen grain or Ovule. The number of daughter cells resulting from the division of a single cell: Four gametes The number of chromosomes in each of the daughter cells: Half the number of chromosomes (n) in the parent cell. The genetic information of the daughter cells Meiosis produces genetically different cells. Due to the occurrence of the crossing-over phenomenon between the homologous chromosomes during meiosis (I)

The purpose of its occurrence in human body:

- 1-Growth of the body of living organism.
- 2-Repairing dead and damaged tissues (tissue regeneration), such as in wound healing, repairing blood vessels, muscles and bone fractures.

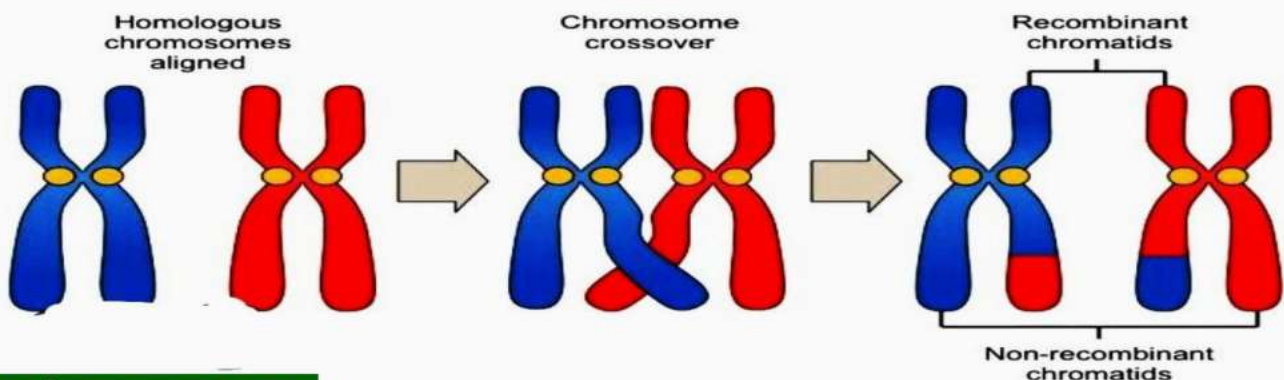
The purpose of its occurrence in human body:

- 1-Production of gametes in the gonads.
- 2-Reduction of chromosome number to half in the gamete, to ensure restoring the original number of chromosomes of the species after mating, so the chromosome count remains constant across the successive generations.

The crossing - over phenomenon

It occurs during meiosis I:

- * Each pair of homologous chromosomes comes close to each other.
- * The ends of non-sister chromatids twist around each other.
- * Genetic material exchange occurs between the twisted ends of the chromatids.



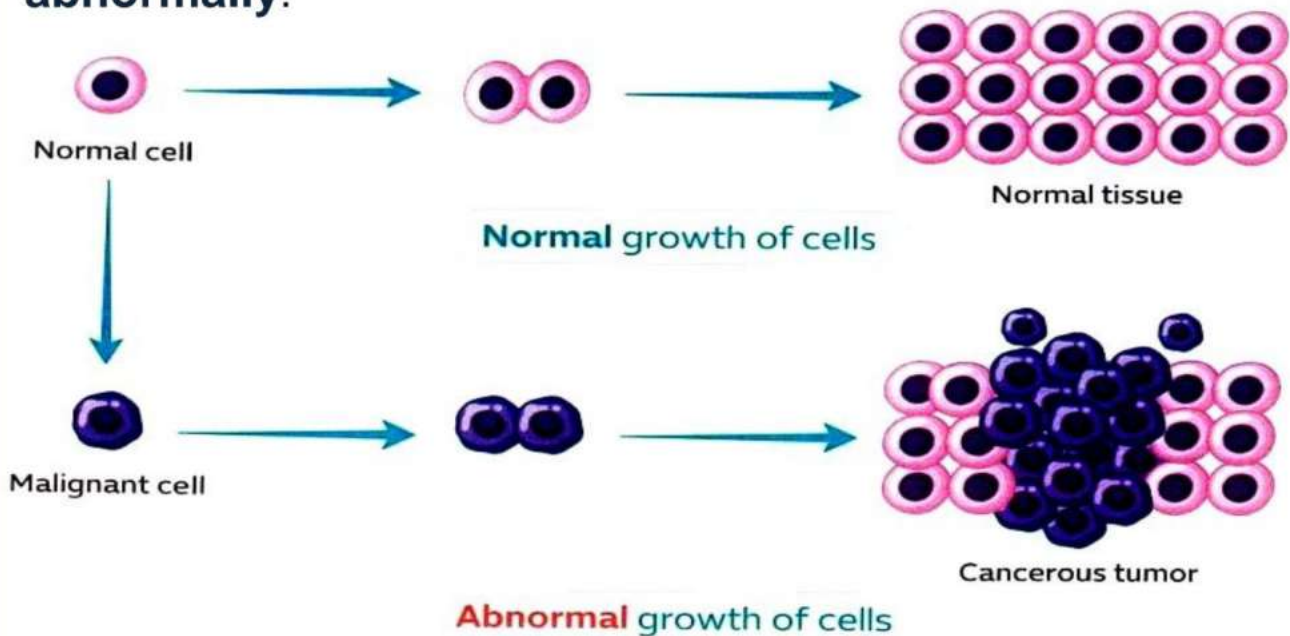
Its importance:

The crossing-over phenomenon leads to diversity (variation) of genetic traits in the individuals of the same species.

Because genetic material exchange occurs between the non-sister chromatids of two homologous chromosomes, which are randomly distributed in the gametes responsible for sexual reproduction in living organisms.

The cancerous (malignant) tumor

It is an abnormal cell growth formed when a somatic cell undergoes uncontrolled mitotic division repeatedly and abnormally.



Types of reproduction in living organisms:

1- Asexual Reproduction

2-Sexual Reproduction

Asexual Reproduction

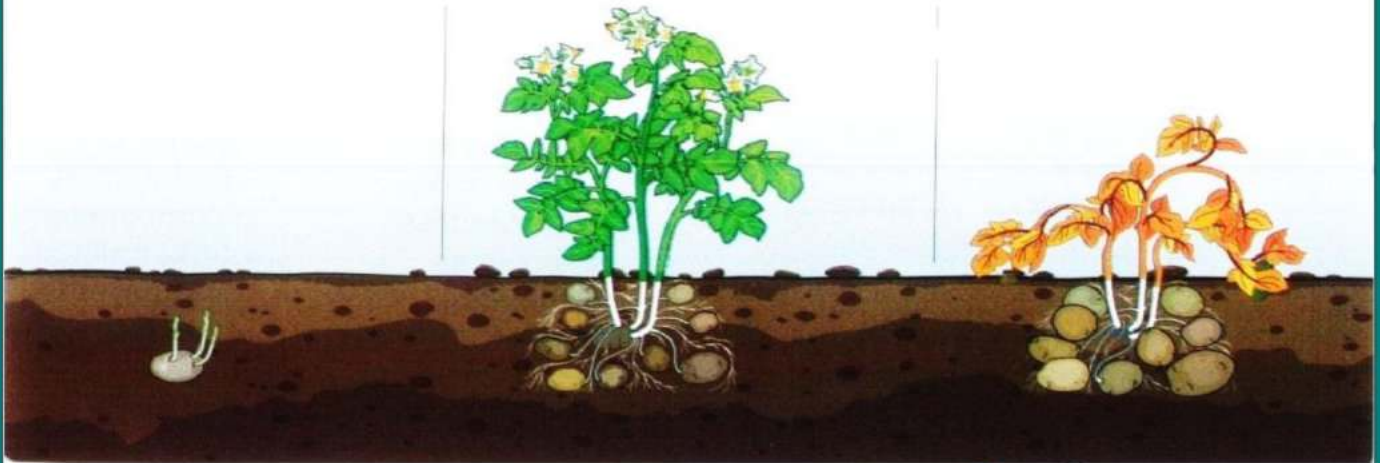
A biological process in which the parent organism produces new individuals that are completely identical to it in their genetic characteristics.

Characteristics of Asexual Reproduction:

- 1-It occurs through a single parent.
- 2-It depends on mitosis (mitotic cell division), which results in producing an exact copy of the parent organism.
- 3- It occurs in several ways, including vegetative reproduction by tubers, as in the potato plant.

Steps of Vegetative Reproduction in the Potato

Plant:-



Step 1:

Potato tubers (**contain buds**) are placed in suitable environmental conditions (**humid medium**) until the buds sprout.

Step 2:

The bud becomes active and develops into a **young stem** which grows upward carrying the growing leaves, at the same time another cells in the bud differentiate to form primary roots that extend downward in the soil.

Step 3:

When roots are able to absorb water and mineral salts from the soil, and also the stem and leaves rise towards the light, so the tuber becomes a new plant that can make **photosynthesis process**.

Note

During the early stages of growth, the tuber functions as a storage organ, acting as an energy reservoir.

Sexual Reproduction

A vital process in which two parental individuals of the same species, one is male and the other is female, participate to produce new individuals that carry a combination of genetic traits of both parents.

Characteristics of sexual reproduction:

- 1-It involves two parental individuals of the same species, one is male and the other is female.
- 2-It depends on the occurrence of meiosis, which ensures diversity in the genetic traits of the resulting individuals.

Stages of sexual reproduction

Fertilization

It is the **fusion** of the nucleus of a **haploid male gamete (n)** with the nucleus of a **haploid female gamete (n)** forms a **zygote** carrying complete chromosome count of the species (**diploid 2n**)

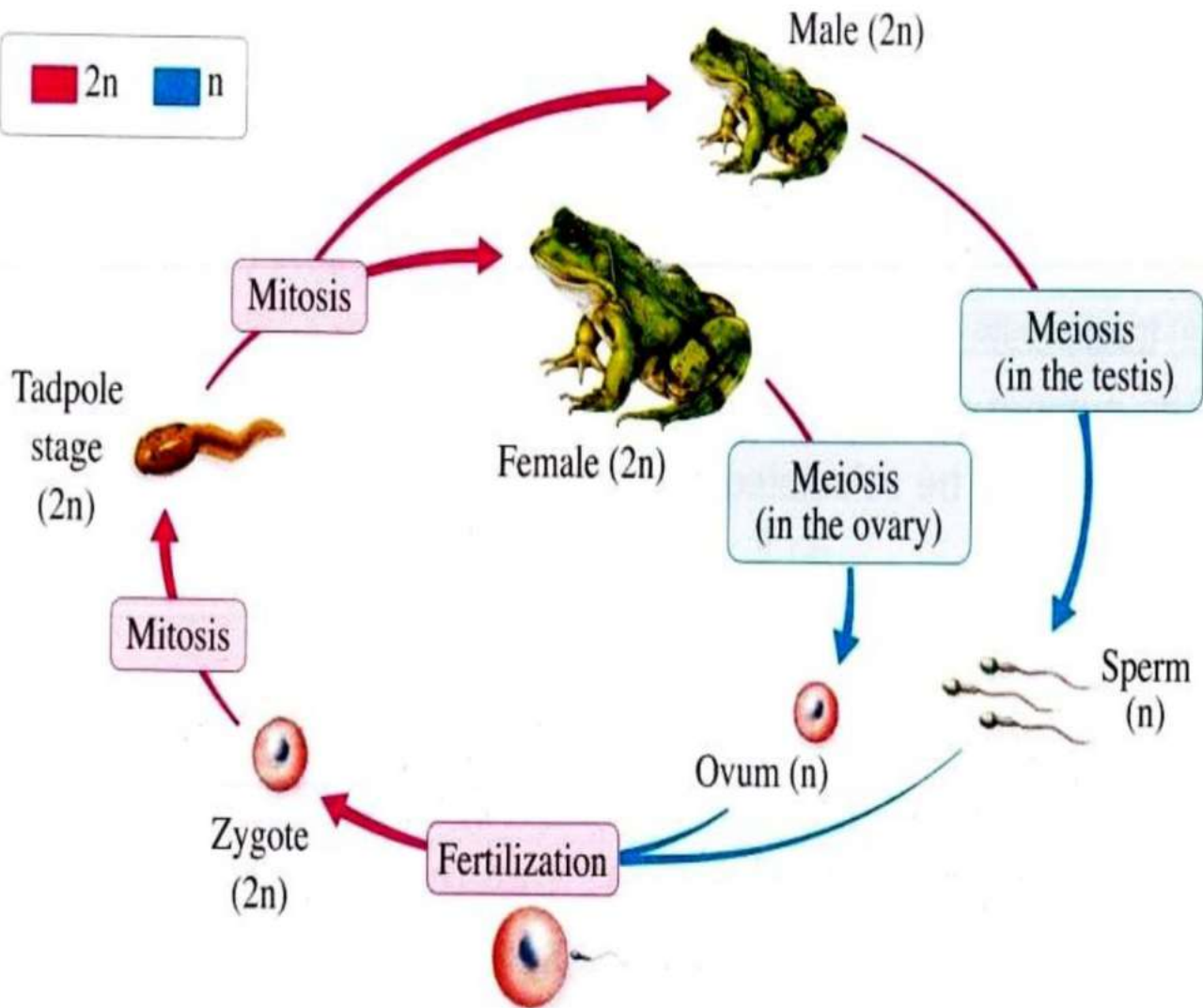


Zygote undergoes mitotic division to form the embryo that carries a combination of the traits of both parents.



Zygote

The cell resulting from the fertilization process, which contains the complete chromosome count of the species.



Unit (3) Lesson two

Floral Reproduction

-Flowering plants are one of the most widespread plants in different environments around the world.

Give reason:

The most important plants to humans.

Because human get his food from them.

Flowering plants ensure the continuity of their species through sexual reproduction, which takes place in the flowers.

*Origin of flowers:

★ The flower develops from a **vegetative bud** that undergoes modification to perform a reproductive function.

★ **Bract:** the leaf which the vegetative bud emerges from its axil and develop into flower

★ **inflorescence:** a cluster (group) of flowers carried by peduncle.

★ **Peduncle:** the part of the stem part that carries a cluster of flowers.

★ Inflorescences vary in shape as the following:



Simple raceme	Simple corymb	Simple umbel

Some inflorescences have a long main peduncle that continues to grow, bearing flowers on all sides. Each flower is carried on a small stalk, giving the inflorescence a shape similar to a cluster of grapes. The flowers open sequentially from the bottom, where the older flowers are found toward the top, where the younger flowers develop.

other inflorescences possess a short main peduncle that stops growing after producing a number of flowers, which arise only from the sides of the axis. This gives the inflorescence a comb-like shape. The flowers open from the outside (oldest) to the center (youngest). All flowers are found at nearly the same level.

In another type of inflorescence, all flowers arise from a single point at the tip of the peduncle, a structure that resembles an umbrella or tent. The older flowers are on the outside and the youngest flowers are in the center, and their pedicels are equal in length.

Examples:

Snapdragon and stock flowers

Examples:

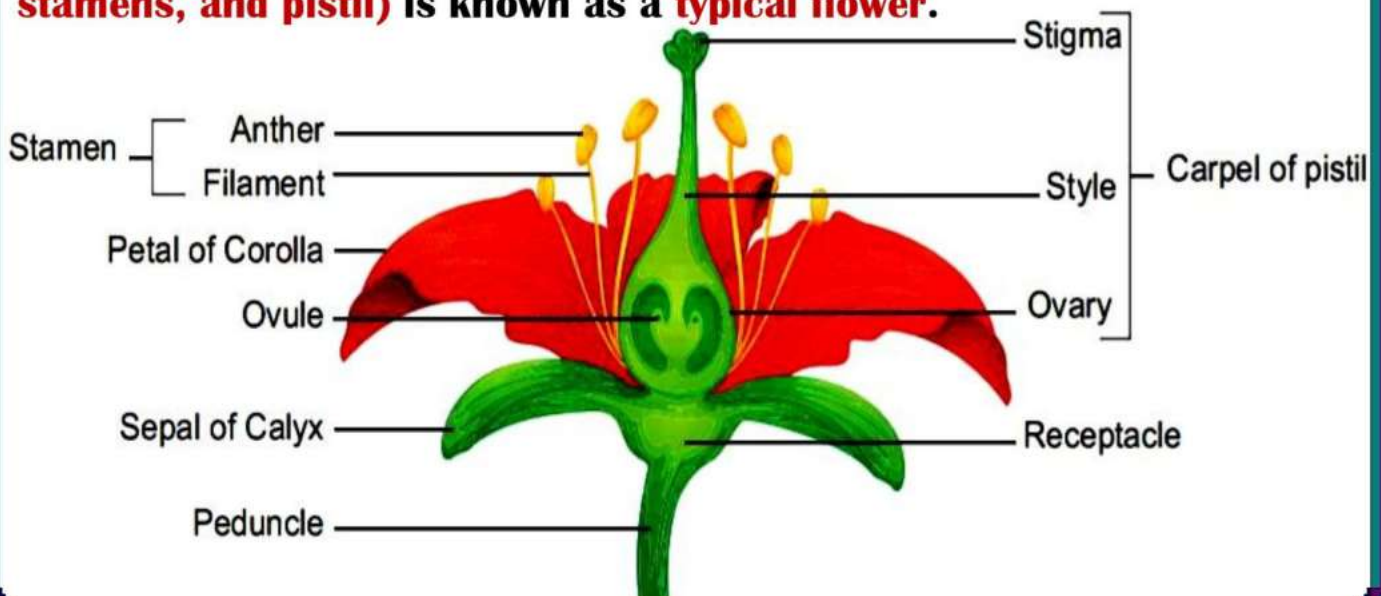
Cherry and Iberis (candytuft)

Examples:

Garlic and onion

* Flower structure:

- The flower consists of a slender stalk (**pedicel**) which ends in a swollen part (**the receptacle**).
- The receptacle bears the floral leaves, which are arranged in groups called **floral whorls**.
- A flower that contains four distinct floral whorls (**calyx, corolla, stamens, and pistil**) is known as a **typical flower**.



Arrangement of floral whorls from outside to inside:

1- Calyx:

The calyx is composed of green leaves called **sepals**, whose number varies from one type of flowers to another. Sepals may be separate (**not attached** to each other), as in **the rose flower**, or **fused**, as in the **petunia flower**.

-Function: to protect the inner parts of the flower, especially before blooming.

2- Corolla:

The corolla lies internal to the calyx and consists of **delicate white or colored leaves called petals**. Petals are often fragrant, **helping to attract insects that assist in the process of floral reproduction**. The number of petals usually equals the number of sepals and alternates with them in position. Petals may be fused and arranged in a single whorl, **as in the petunia flower** or separate and arranged in several whorls, **as in the Egyptian rose flower**.

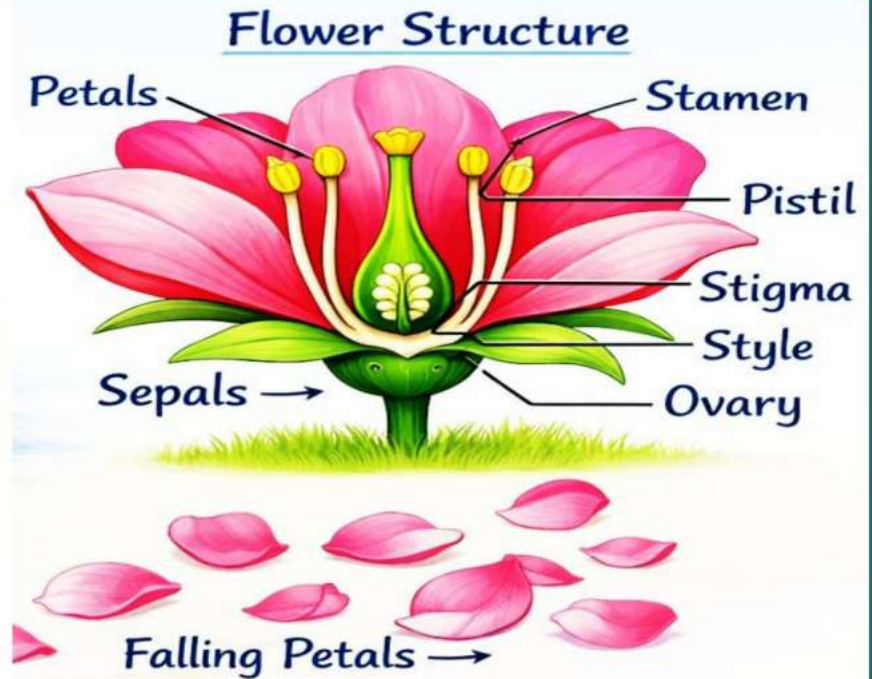


Petunia petals
fused and arranged in one whorl



Egyptian rose petals
separate and arranged in several whorls

-Function: protecting the reproductive organs of the flower and in attracting pollinating insects that play a vital role in completing sexual reproduction.



3-Stamens:

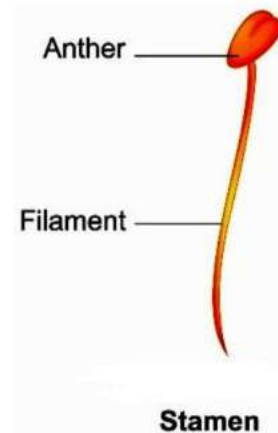
The male organ of the flower lies just inside the corolla

Stamen consists of several modified leaves called Stamens.

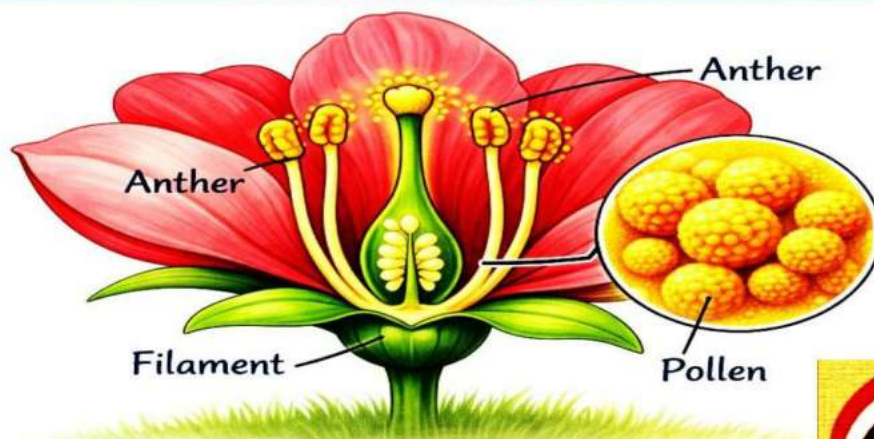
Each stamen is made up of :

Thin filament ends in a swollen structure known as the anther.

The anther typically consists of two lobes, each containing two pollen sacs filled with tiny grains called pollen grains.

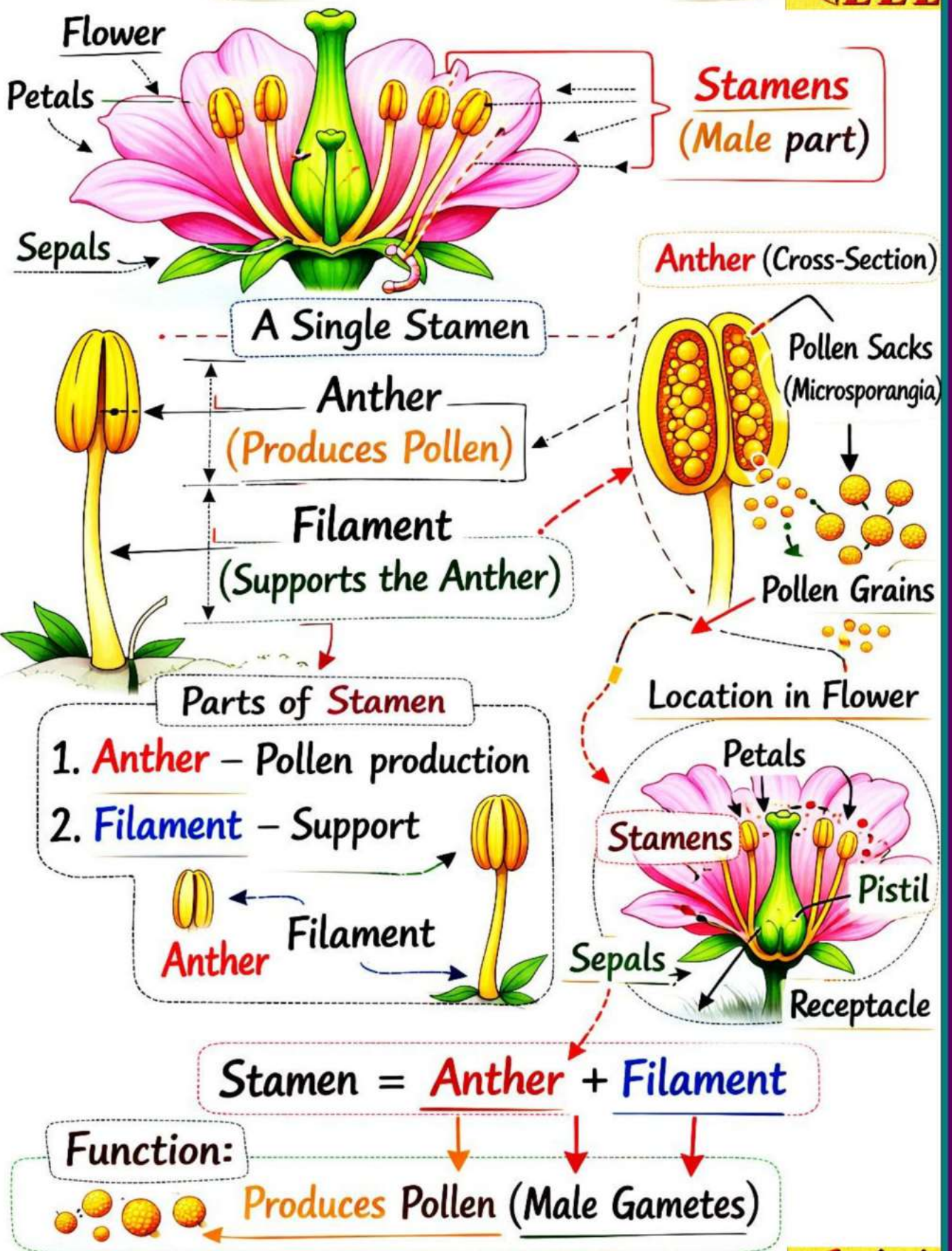


Stamen



Anther & Filament = Stamen

Structure of Stamen

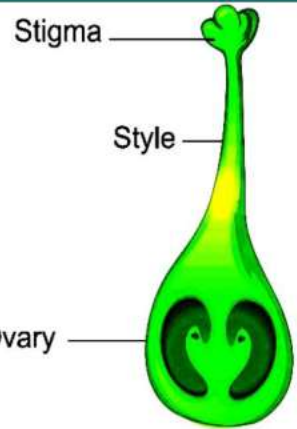


4-Pistil:

The female organ is located at the center of the flower and consists of one or more leaves called carpels, collectively forming the pistil, which resembles a flask in shape.

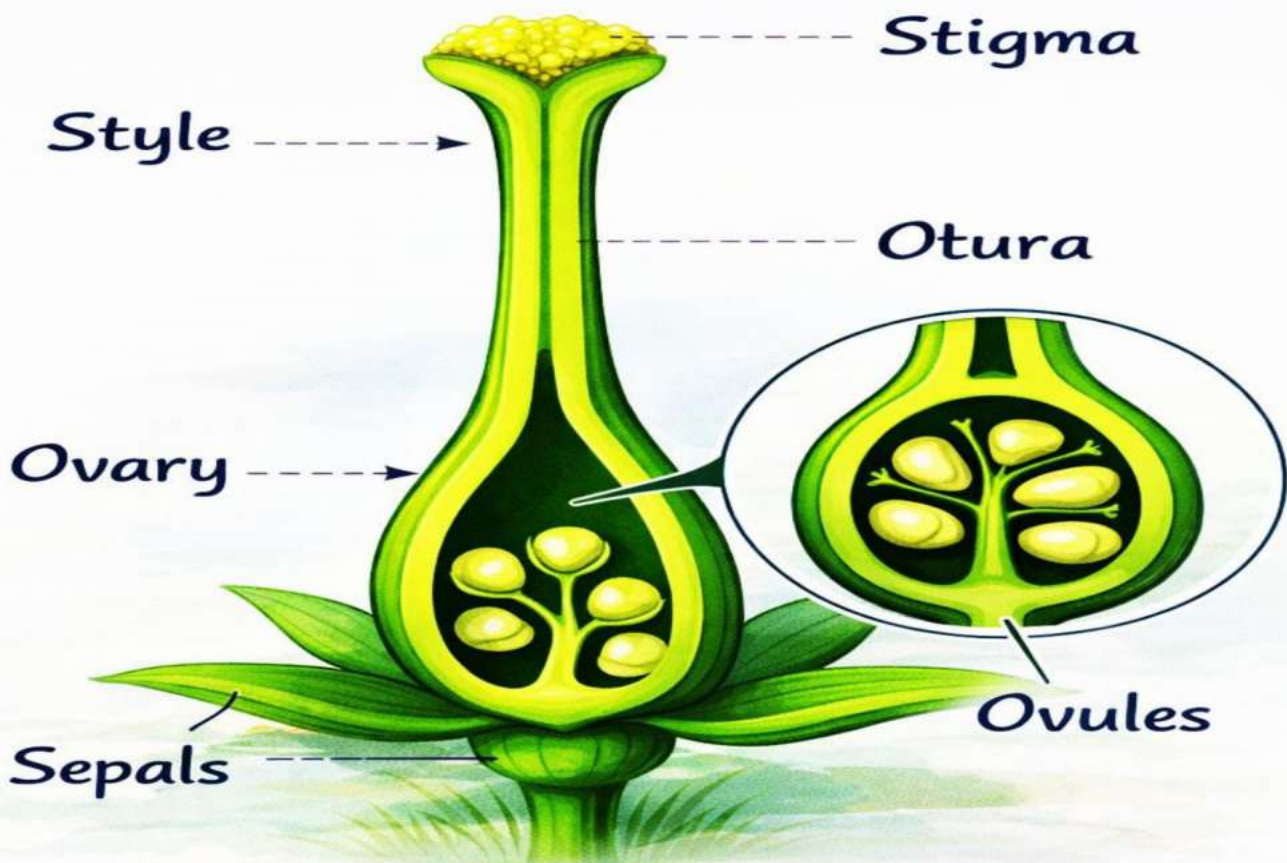
Each carpel includes:

A swollen base (**ovary**) connected to a slender tube (**style**), which ends in a sticky surface (**stigma**).



Carpel

Structure of Carpel



Carpel = Pistil

Note:

In some flowers, such as the daffodil: sepals cannot be distinguished from petals, based on color or appearance.

In these flowers, the calyx and corolla are collectively referred to the perianth.

In some flowers lack both sepals and petals naked flowers, such as **Willow flowers** and daffodil flower.



Daffodil flower



Willow flowers

*Medical science:

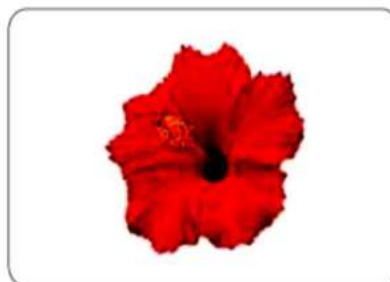
Flowers have many medical benefits because they contain antioxidants and volatile oils.

Example:

- **Chamomile flowers** which are used to calm the nervous system.
- **Hibiscus flowers** which help lower high blood pressure.
- **Lavender flowers** which are used to relieve muscle pain and headache.



Chamomile flowers



Hibiscus flowers



Lavender flowers

*The sex types of the Flower:



1- Bisexual flowers: contain both male and female reproductive Organs, symbolized by (♂).

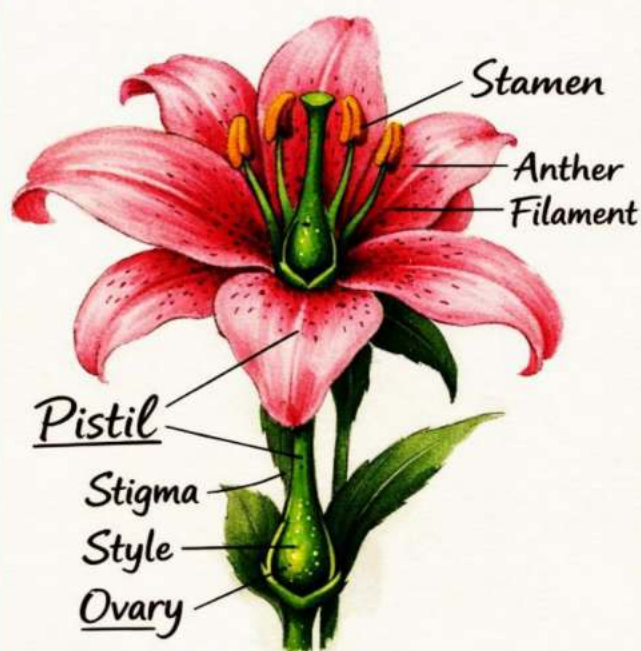
-Examples: tomato and eggplant flowers.

2-Unisexual flowers contain **only the gynoecium** without the stamens and are classified as **female flowers**, symbolized by (♀).

Others contain **only the stamens** without the pistil and are classified as **male flowers**, symbolized by (♂).

-Examples: palm, maize (corn), and Pumpkin flowers.

Bisexual Flower



Unisexual Flower



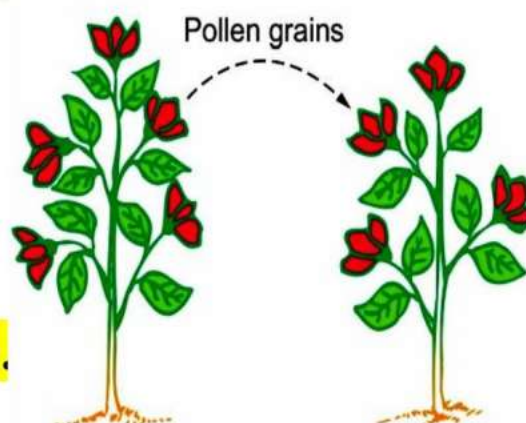
Male Flower



Female Flower

Pollination:

It is the transfer of pollen grains from the anthers of the stamens to the stigmas of the carpels (pistils).



► Types of pollination:

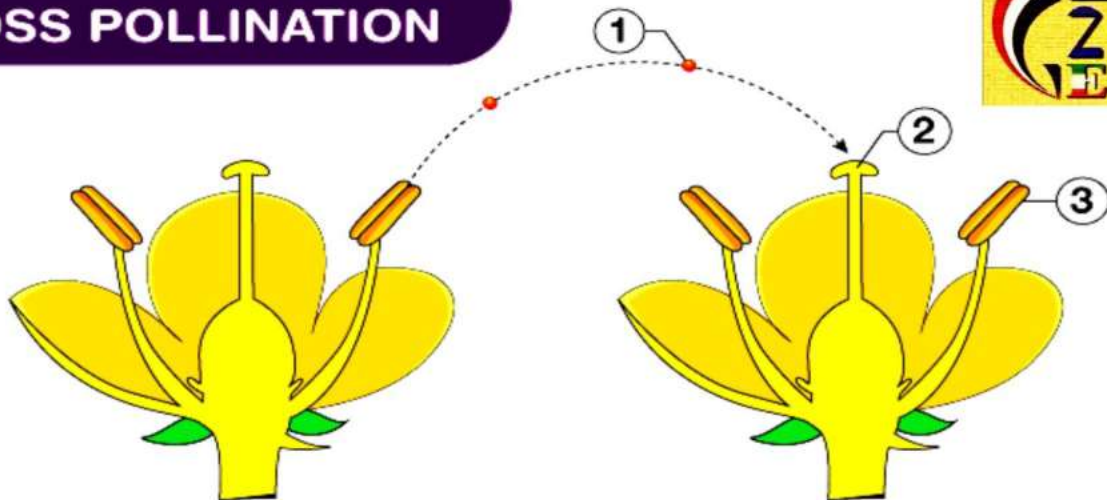


1-Cross - pollination occurs when pollen grains are transferred from the anther of a flower on one plant to the stigma of a flower on another individual of the same species.

Flowers that undergo cross-pollination are characterized by the following features:

- (1) Stamens and pistils do not mature at the same time.
- (2) Anthers are positioned far from stigmas or at a lower level.
- (3) The flowers are unisexual.

CROSS POLLINATION



Cross Pollination occur when pollen grains are transferred to a flower from a different plant.

① Pollen | ② Stigma | ③ Anther

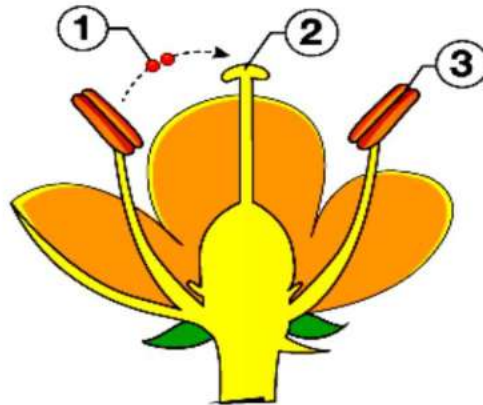
2-Self - pollination occurs when pollen grains are transferred from the anther to the stigma of the same flower or to the stigma of another flower on the same plant.

Flowers that undergo self-pollination are characterized by:

- (1) Simultaneous maturity of the stamens and the pistil.
- (2) Anthers are at the same level as, or slightly higher than, stigmas.
- (3) In some cases, the flower remains closed and does not open until pollination is completed.



SELF POLLINATION



The pollination of a flower by pollen from the same flower or from another flower on the same plant.

① Pollen | ② Stigma | ③ Anther

Methods of pollination

-Including: wind, insects, water, and humans.

-Characteristics of wind - pollinated flowers:

- 1-Their petals are small and dull-colored.
- 2-They are usually scentless and do not produce nectar.
- 3-Their anthers are long and hang outside the flower, making them easy to shake by the wind.
- 4-Their pollen grains are light, dry, and smooth, and are produced in large quantities to compensate for losses in the air.
- 5-Their stigmas are feathery, sticky, and often exposed outside the flower to trap pollen grains.



Anthers are long and hang outside

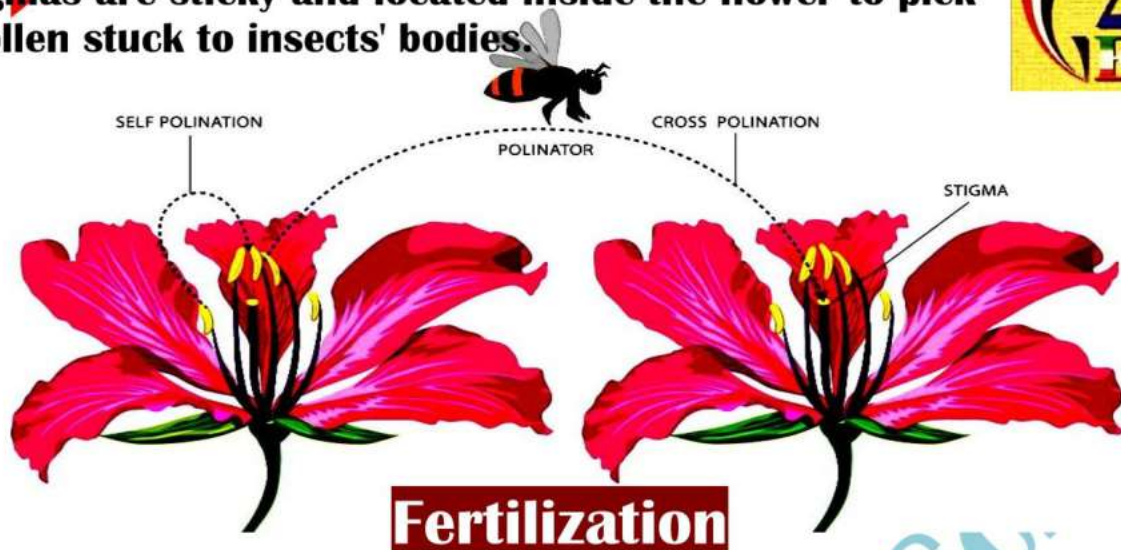
-Characteristics of insect - pollinated flowers:

- 1-Their petals are large with bright colors.
- 2-They have a noticeable scent and secrete nectar to attract insects.
- 3-Their anthers are located inside the flower due to short filaments.
- 4-Pollen grains are sticky or rough, allowing them to adhere to the bodies of visiting insects.



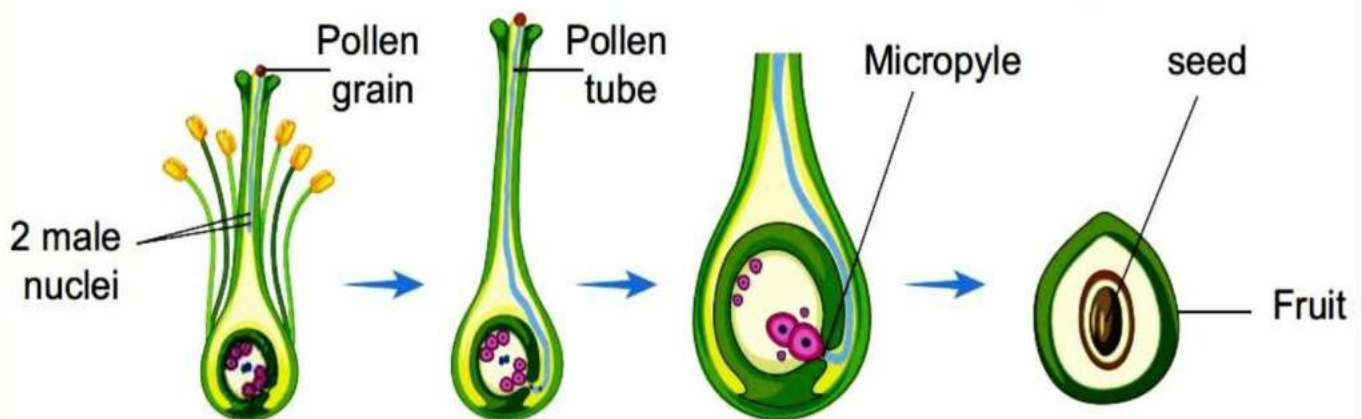
Large bright petals

5-Stigmas are sticky and located inside the flower to pick up pollen stuck to insects' bodies.



Fertilization

-When a pollen grain falls on the stigma of a flower of the same



Fertilization process and fruit formation

species, the stigma secretes a sugary solution that the pollen grain absorbs. This causes the pollen grain to germinate and form a structure known as the pollen tube.

***The generative nucleus of the pollen grain divides mitotically to produce two male nuclei (n).**

***The pollen tube grows down through the style and reaches the ovule through the micropyle.**

***The tip of the pollen tube then breaks down, allowing fertilization to occur when one male nucleus fuses with the ovule nucleus to form a fertilized ovule (zygote) with a diploid chromosome number (2n).**

*** The zygote divides mitotically to form an embryo, which develops into a seed that can germinate to produce a new plant.**

-After fertilization, the ovary enlarges and develops into a fruit, while

the ovules inside the ovary become seeds. After fruit formation, the calyx, corolla, androecium, style, and stigma usually wither and fall off.

* In some plants, certain floral parts may remain attached: the calyx persists in tomato and eggplant, the corolla remains in cucumber and zucchini and both stamens and sepals persist in pomegranate.



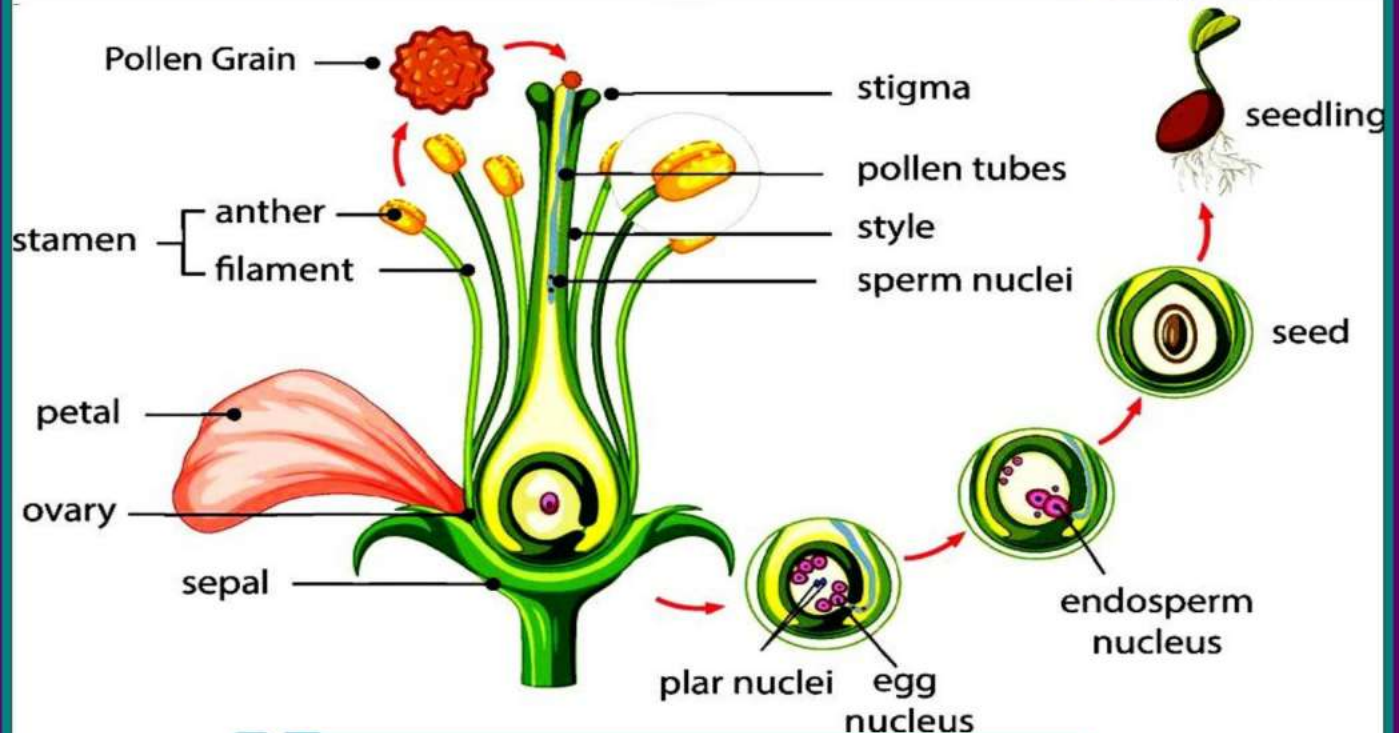
Calyx in Egg plant



Corolla in Zucchini



Stamens and sepals in Pomegranate



*Life Cycle of Flowering Plants

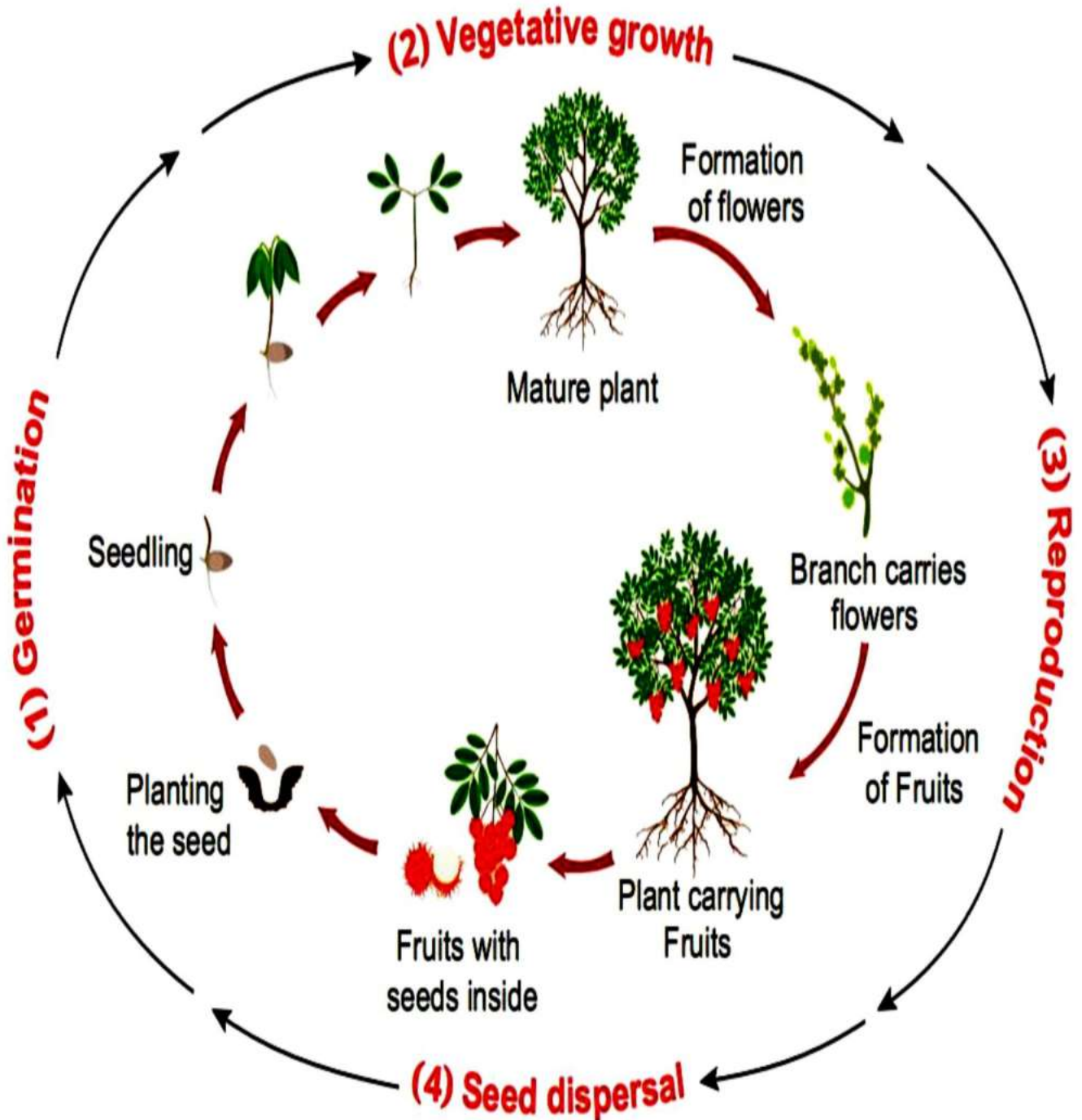
The life cycle of flowering plants passes through four main stages:

1-Germination: During this stage, the seed develops into a seedling that begins to emerge from the soil.

2-Vegetative growth: The plant forms its roots, stem, and leaves.

3-Reproduction: The mature plant produces flowers, which then form fruits containing seeds.

4-Seed dispersal: Seeds spread by various methods to reach new locations, where a new life cycle begins.



Life cycle of flowering plants

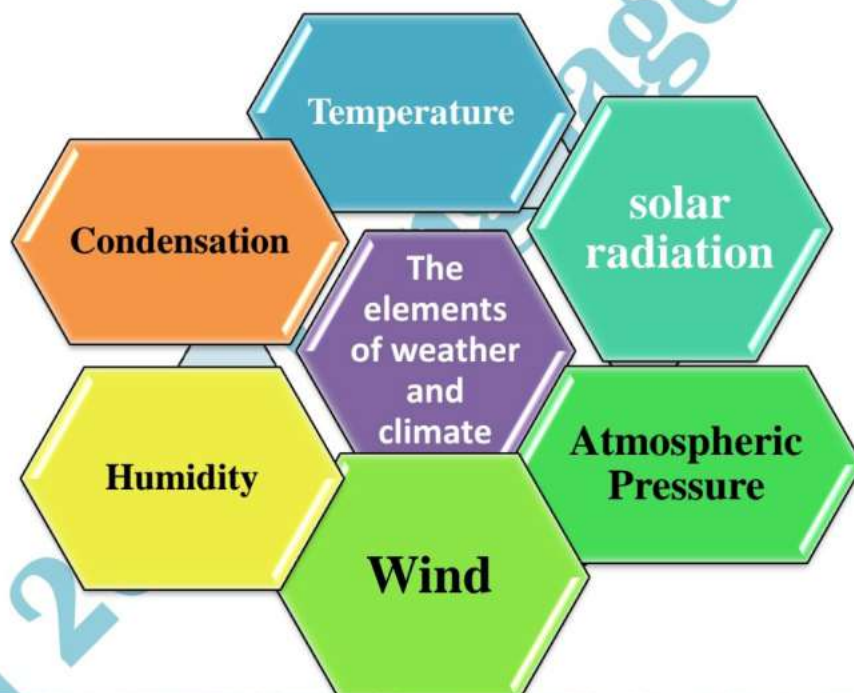


Effect of Temperature & Climate



• Compare between weather and Climate?

Weather	Climate
The overall instantaneous condition of the atmosphere at certain place and time.	The atmospheric condition in a certain place over a long period of time.



Temperature is considered the **most important climatic element**. Because of its direct impact on human life and.

The distribution of plants and animals on the Earth's surface



Caracal

Polar Bear

➤ Factors affecting the temperature:



Differences in
latitude

Proximity to
water bodies

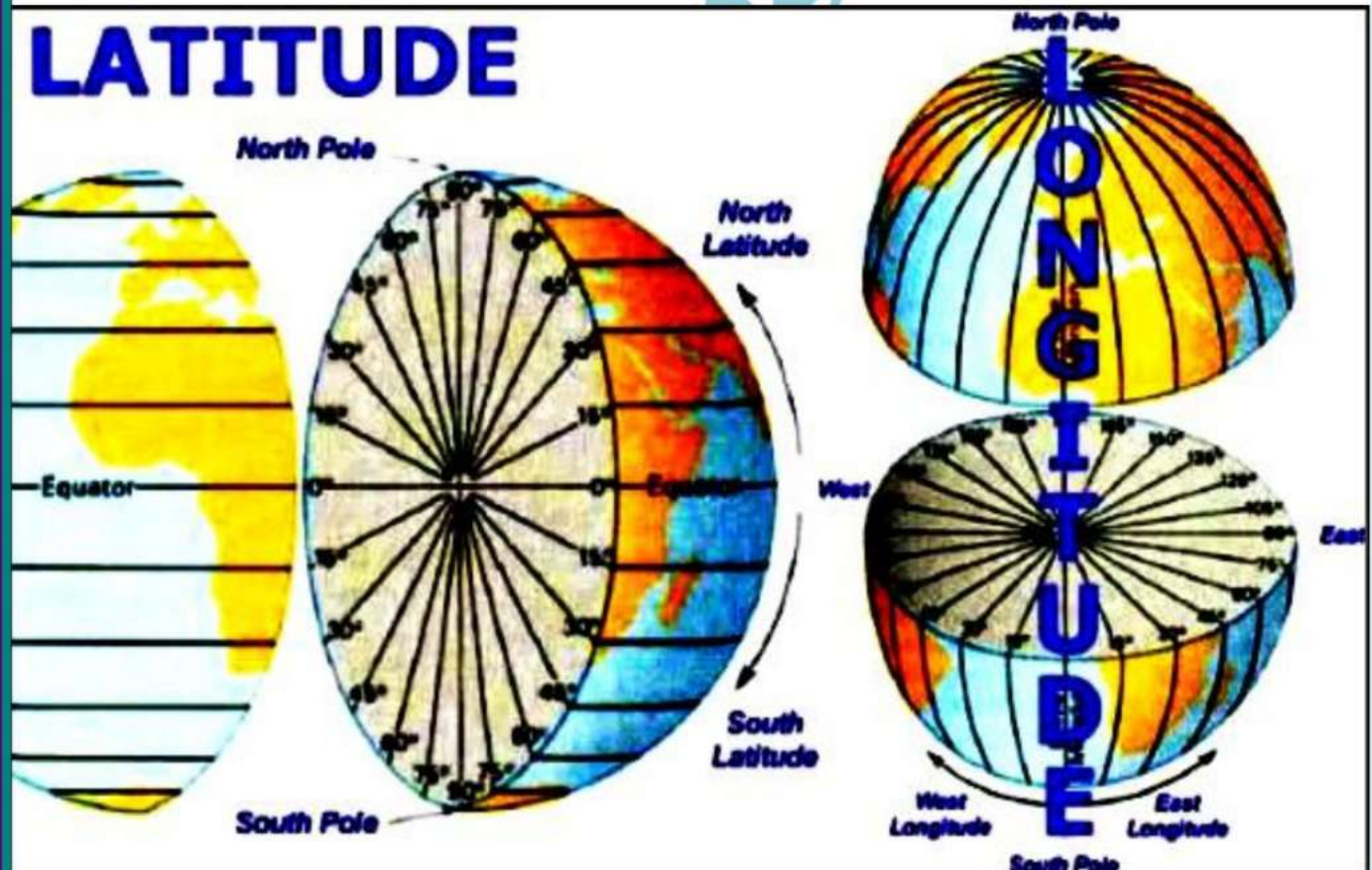
Altitude above
sea level

1- Difference in latitude

The location of any place on the Earth's surface is determined using two sets of lines, which are:

- Longitudes
- Latitudes

LATITUDE



- There are several main latitudes:

➤ Tropic of Cancer:

It is the latitude that is located north of the equator, and it is referred to as 23.5°N .

➤ The Equator:

It is the latitude that bisects the Earth's surface at the middle between the two poles and it is referred to as 0°

➤ Tropic of Capricorn:

It is the latitude that is located south of the Equator, and it is referred to as 23.5°S

(G. R) Temperature is high near the Equator.

→ Because the Sun rays fall perpendicular.

(G. R) Temperature decreases as you move north or south farther from the Equator towards the poles.

→ Due to the increase in the angle of inclination of the Sun rays falling on areas.

Notes:

1-The distribution of thermal zones in the world varies according to **latitudes**.

2-Egypt lies between latitudes **22°N and 32°N** ,
the location of Aswan (24°N) near the tropic of Cancer makes its climate extremely hot and dry throughout the year and **it is the hottest and driest city in Egypt**.

3 -When the specific heat of a substance is high:

The amount of heat required to raise the temperature of **1kilogram** of the substance by **1°C** is large (and vice versa). Therefore, the increase in temperature of a certain mass of the substance is small when it gains a certain amount of heat.

4-The substance takes a long time to lose the energy it has gained (i.e. it cools down slowly).

2- proximity to water bodies:

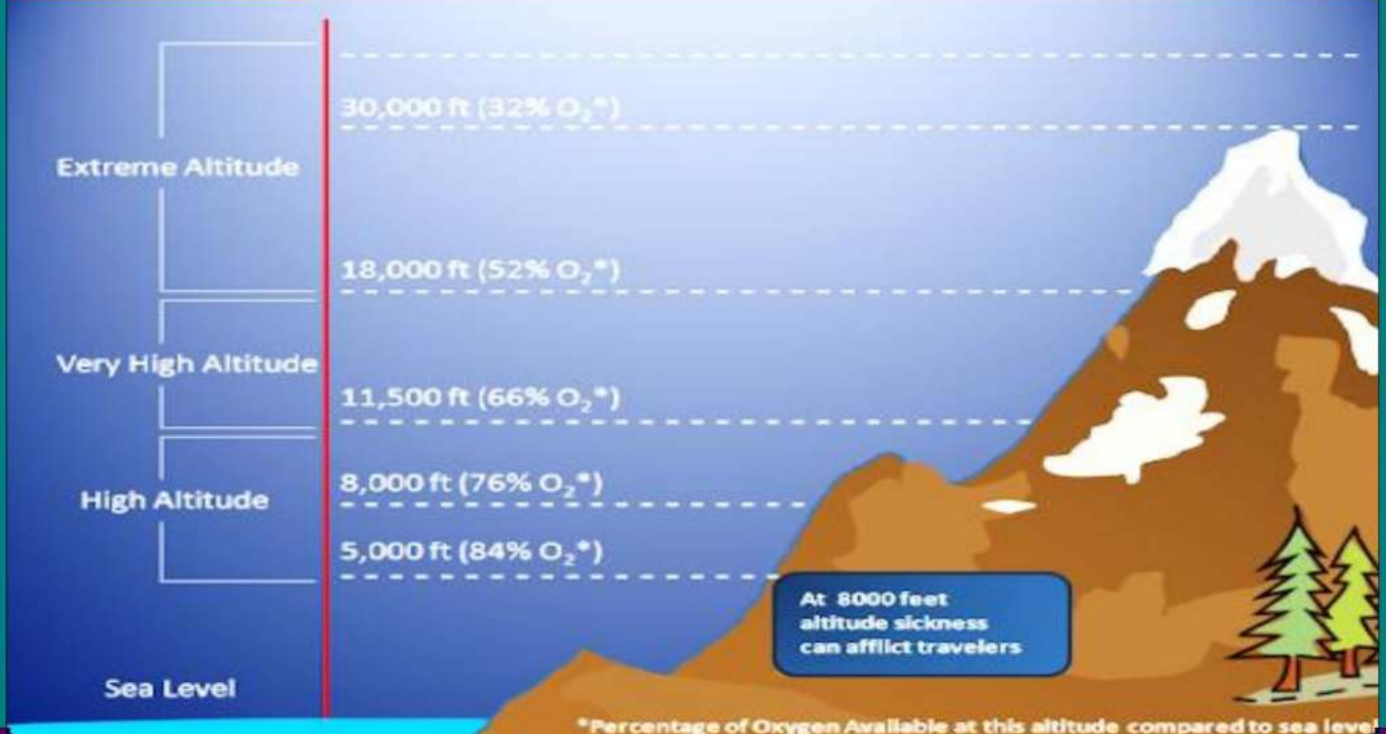
Note : The specific heat of water, being higher than that of the adjacent



- Water heats up and cools down slowly.
- Land heats up and cools down quickly.



	sea breeze	land breeze
Definition	The movement of cool, refreshing air from the sea towards the land during the daytime.	The movement of cool, relatively dry air from the land towards the sea at night.
Reason for occurrence	Water bodies are cooler than the adjacent land during the daytime	Water bodies are warmer than adjacent land at night.
How it occurs?	The air above the land during the daytime is hotter than the air above the sea.	The air above the sea at night is warmer than the air above the land.





(G. R) In sea breeze the hot air rises above the land.

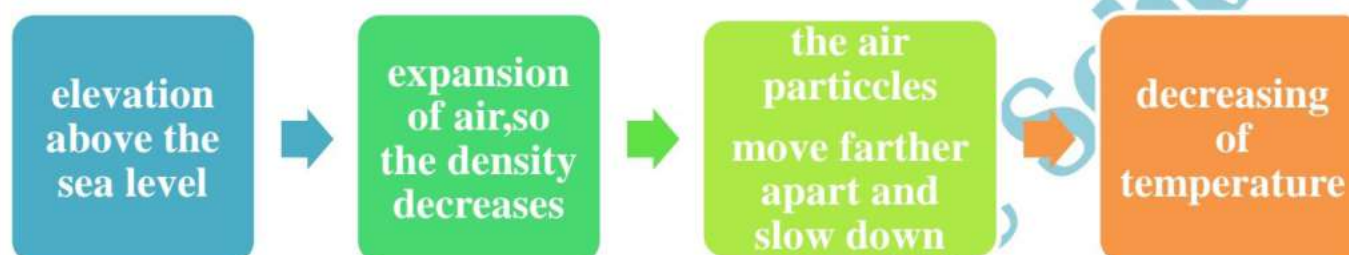
→ Due to it has low density and it is replaced by cool air from the sea.

(G. R) In land breeze the warm air rises above the sea.

→ Due to it has low density and it is replaced by cool air from the land.

3 - Altitude above sea level

Air density decreases as altitude increases above sea level.



Maximum and minimum temperatures

The weather forecast shows the maximum and minimum temperatures for each day

Maximum temperature : The highest temperature in one day.

Minimum temperature : The lowest temperature in one day.

Daily temperature range : The difference between the maximum and minimum temperatures for one day.

Daily average temperature : The arithmetic mean of the maximum and minimum temperatures for one day.



Proving That Atmospheric Air Has Pressure



Does air have pressure?

Materials



Peeled boiled egg



Empty glass bottle



Empty glass bottle



Pieces of paper

Steps

1



Put some pieces of paper inside the bottle.

2



Light the pieces of paper with a match.

3



Quickly place the **peeled boiled egg** on the mouth of the bottle.

Observation

The egg is sucked into the bottle after the flame goes out.

1



As the **paper** burns, the trapped air inside the bottle heats up.

2



After the flame goes out, the air inside cools down, causing its pressure to decrease.

3



The pressure outside is now greater, which pushes the egg inside.

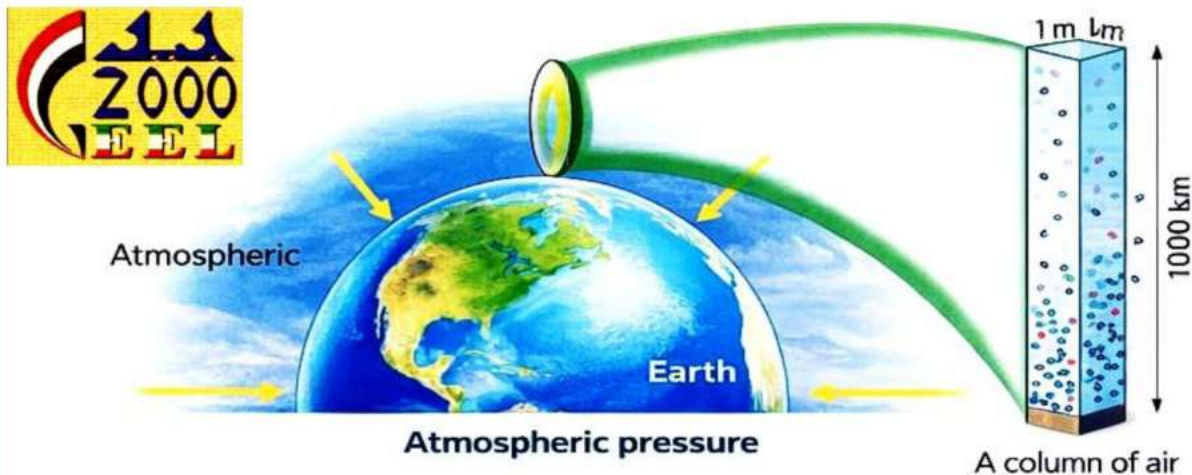
Explanation

As the paper burns, the trapped air inside the bottle heats up, expands, and its pressure increases.

Atmospheric Pressure

Atmospheric pressure

The weight of a column of air with a cross-sectional area of 1 m^2 extending from the Earth's surface to the top of the atmosphere.



Measuring Atmospheric Pressure

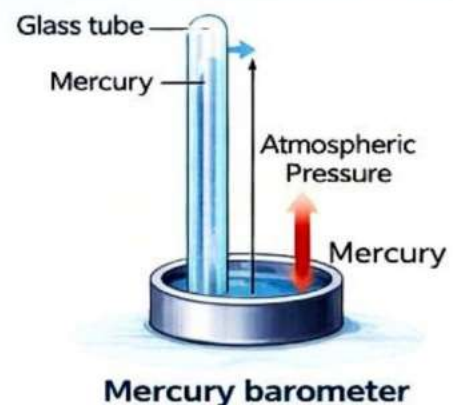
- Atmospheric pressure is measured using a device called a **mercury barometer**.
- At sea level, atmospheric pressure is known as **normal atmospheric pressure**.

Normal atmospheric pressure:

760 mm Hg (millimeters of mercury) =
1013.25 millibars (mb)

- 1 millibar (mb) = 0.75 mm Hg

$$\text{Atmospheric pressure (millibar)} = \frac{\text{Atmospheric pressure} \cdot (\text{millimeter mercury mm Hg})}{0.75}$$



Factors Affecting Atmospheric Pressure

There are several factors that affect atmospheric pressure:



Altitude

(height above sea level)



Temperature

Temperature



Humidity

Humidity



Atmospheric Pressure & Altitude



Explanation

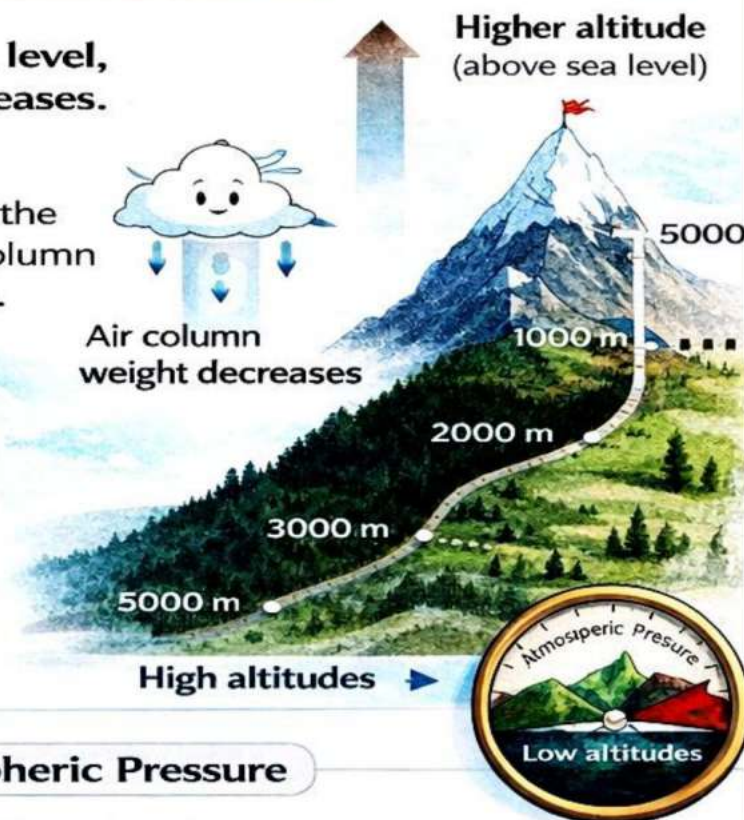
As we go **higher** above the sea level, the atmospheric **pressure decreases**.

Why?

Because as we go **higher** above the sea level, the **weight** of the air column acting on the unit area **decreases**.

Altitude (m)	Atmospheric Pressure (mb)
Trouer	
1000	899.76
2000	795
3000	701
5000	540.2

(For illustration only)



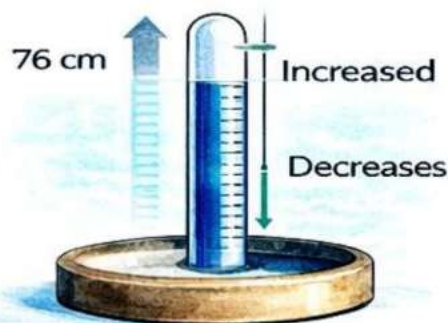
Effects of Altitude on Atmospheric Pressure

Decrease in atmospheric pressure causes:

- Decrease in the column of mercury and
- Increase in Torricelli's vacuum.

Question & Solution

If the atmospheric pressure in an area is **1000 mb**, what is the length of the mercury column inside a mercury barometer, in centimeters.

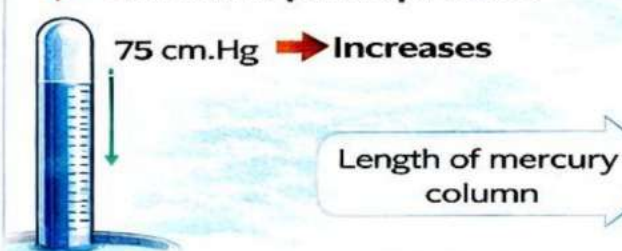


Barometric Changes

High atmospheric pressure

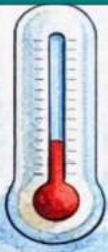


Low atmospheric pressure



! The area is located above sea level because the atmospheric pressure is less than 76 cm.Hg.

Temperature & Atmospheric Pressure



Increase in temperature

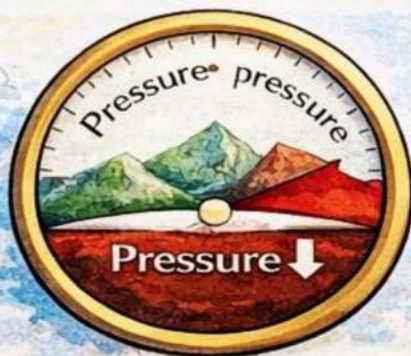


And
vice versa

**Expansion of air
near Earth's surface**

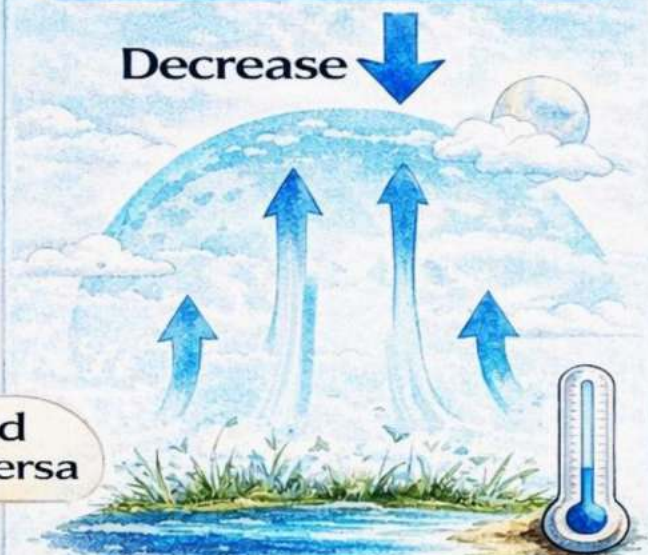
**Decreasing air density
therefore**

**The atmospheric
pressure decreases**



**The atmospheric pressure
decreases**

Decrease in temperature



**Contraction of air
near Earth's surface**

**Increasing air density
therefore**

**The atmospheric
pressure increases**



**The atmospheric pressure
increases**



Humidity



The amount of water vapour present in the air.

- The percentage (value) of humidity varies:
 - ♦ from one place
 - ♦ from one time

and



The concept of absolute humidity differs from the concept of relative humidity.

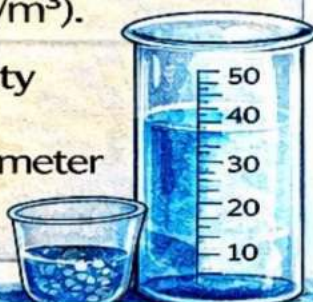
Absolute Humidity



Absolute Humidity

The actual mass of water vapour present in a certain volume of atmospheric air measured in (g/m^3).

Absolute humidity is measured in grams per cubic meter (g/m^3).



Relative Humidity



Relative Humidity

The percentage of the actual amount of water vapour present in a certain volume of air (absolute humidity) to the maximum amount of water vapour that the same volume of air can hold at the same temperature (maximum capacity).



Calculating Humidity



Formulas:

• **Absolute Humidity** = $\frac{\text{Mass of water vapour (g)}}{\text{Volume of air (m}^3\text{)} \searrow 3 \text{ g/m}^3}$

Relative Humidity (%) = $\frac{\text{Actual water vapour (g/m}^3\text{)}}{\text{Maximum capacity (g/m}^3\text{)}} \times 100$

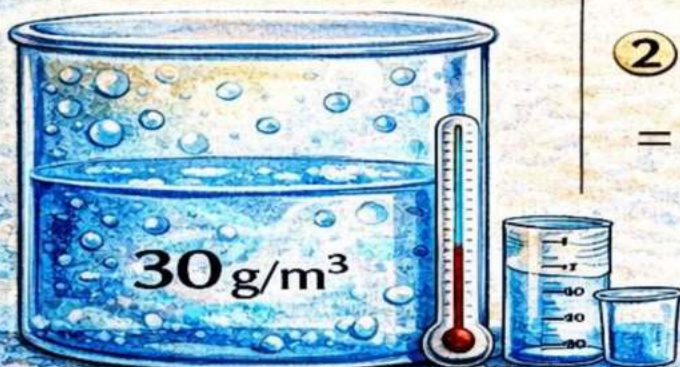
Examples:

1 Absolute Humidity

- Volume of air = 5 m³
- Water vapour = 40 g

Absolute Humidity = 40 g/m³

AH = 8 g/m³



Absolute humidity

2 Relative Humidity

= $\frac{\text{Maximum capacity}}{22.8 \text{ g/m}^3} \times 35\%$



1 Absolute Humidity

- Volume of air = 5 m³
- Water vapour = 40 g

Relative Humidity $\times 100 = 35\%$
 $\frac{8}{22.8} \times 100$



Note:

- Humidity increases ↓
Atmospheric pressure slightly decreases
- Reason: Density of water vapour ←
Density of dry air.



Why Does Influenza Spread More in Winter?



1 The Main Idea

Influenza spreads more in winter due to...

LOW HUMIDITY

Cold air has low humidity



2 What Happens When We Move Indoors?



Cold air → Warm indoor air



Air capacity increases



Absolute humidity stays the same

Relative humidity decreases sharply



Relative Humidity decreases sharply



3 Effects of Low Humidity



On Viruses



Respiratory droplets evaporate quickly



Viruses remain suspended in air longer



On the Human Body



Mucous membranes dry out



Defense against viruses becomes weaker

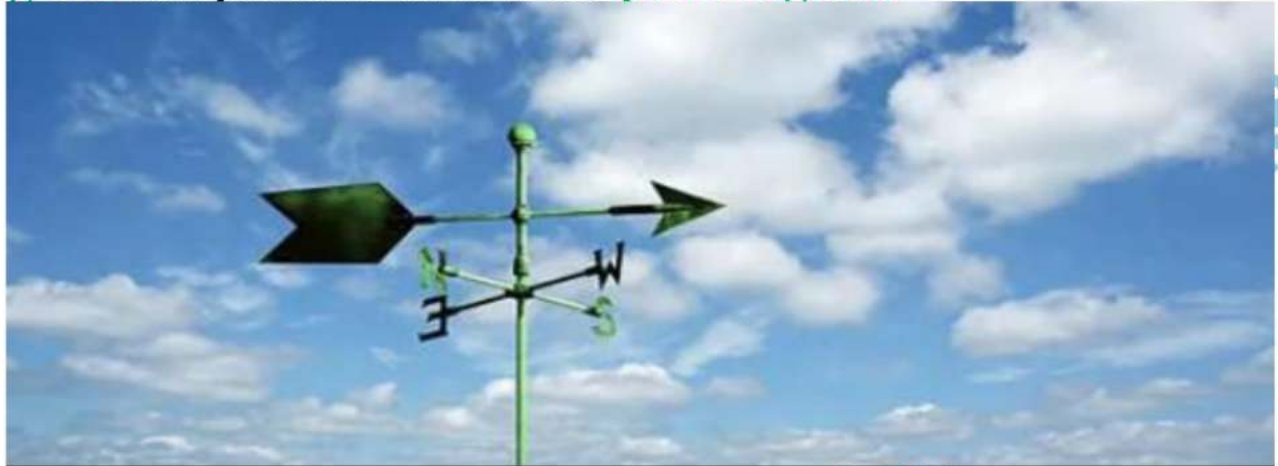


Lesson (2): Wind & weather forecasts



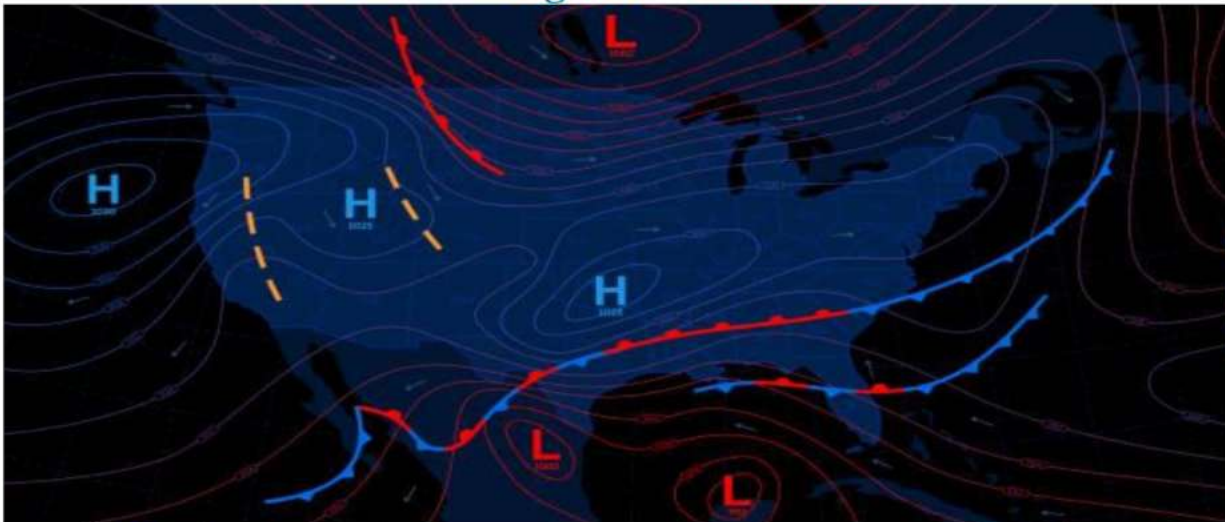
Wind

The **temperature & humidity** differ in the **tropical (equatorial) regions** compared to that in the **polar regions**.



The tropical (equatorial) regions	The polar regions
Sun rays are perpendicular	Sun rays are inclined
rich of large water bodies.	most water is frozen
Increasing of the temperature	Decreasing of the temperature.
humidity Increases due to the high rate of water evaporation.	humidity Decreases due to the low rate of water evaporation.
Heating of the air, make it expand , decreasing its density leading to its rising upward, which leads to Low-pressure region(L)	Cooling of the air, make it contract , increasing its density leading to its sinking downward, which leads to High-pressure region(H)

The air moves from **regions high pressure regions** to **low pressure regions** in **wind form**.



Wind It is the horizontal movement of air across the Earth's, caused by difference in atmospheric pressure between regions, due to unequal heating of the Earth's surface.

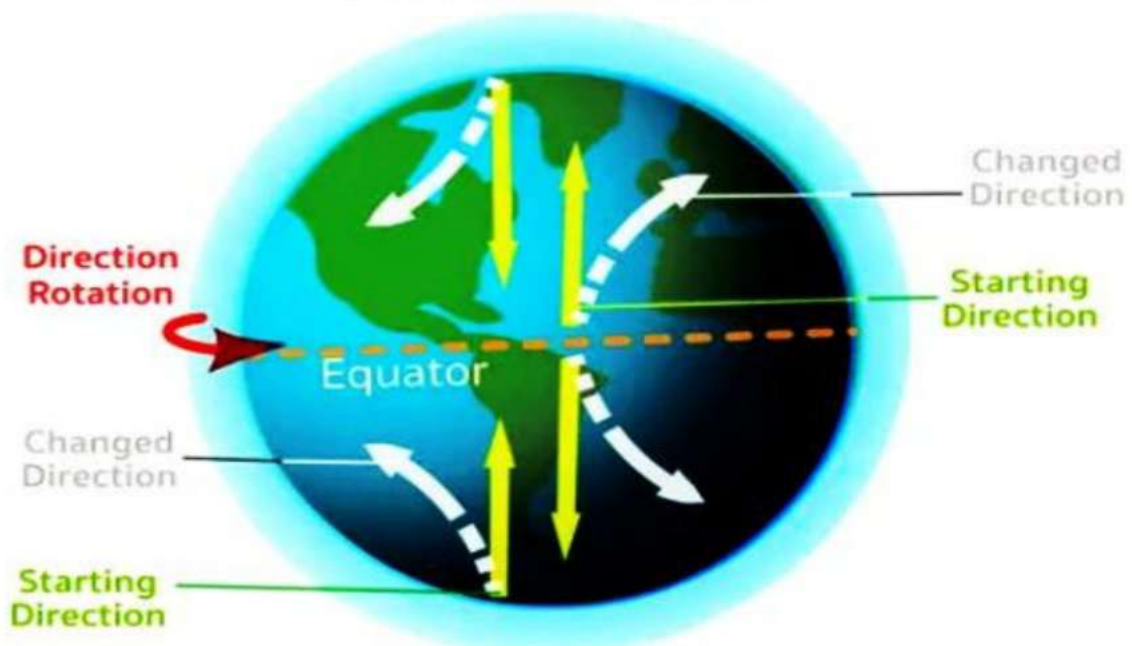
The wind movement & its speed increase, when there is a large difference between atmospheric pressure values in adjacent areas.

The **sea breeze** differs from both **winter storms** & **tropical hurricane** in the pressure difference that causes it and leads to the difference in wind speed,

Coriolis Effect

The wind seems not to move in straight paths, but in curved paths, as a result of the Coriolis Effect.

Coriolis Effect



1. The Southern Hemisphere moves to the left of its original path in an anticlockwise direction (opposite to the direction of the clock's rotation)
2. The Northern Hemisphere moves to the right of its original path in a clockwise direction (in the same direction of the clock's rotation)
3. The wind moves at the Equator in a straight path without deflection, due to the absence of the Coriolis Effect at the Equator.
4. The deflection of the wind is at its maximum at the two poles.

Weather maps

They are maps shows the movement of air masses from one region to another based on wind speed & atmospheric pressure

Isobars (lines of equal pressure)

They are curved lines connecting points of equal pressure at sea level.



Atmospheric pressure systems

pressure systems are classified according to their values into:

1-Low-pressure systems

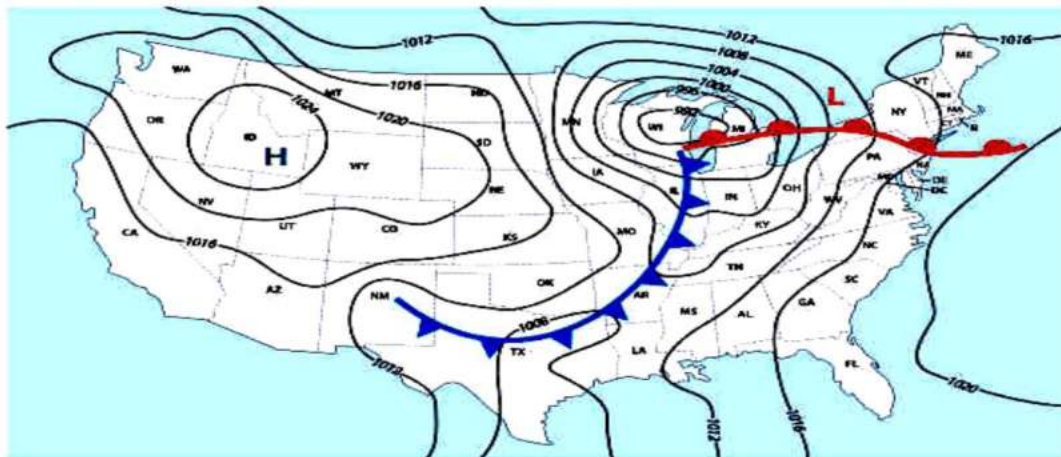
It is a region where the pressure at its center is lower than the surrounding .

Low-pressure system is symbolized by the **letter L in red color**.

★ The values of atmospheric pressure of isobars increase as you move away from the center of the low-pressure system.

Low-pressure regions form rising air currents, rotating towards the center of pressure in an anticlockwise direction at the regions located in the Northern Hemisphere.

The rising air currents in areas of low-pressure lead to their cooling & condensation, forming clouds & rainfall.



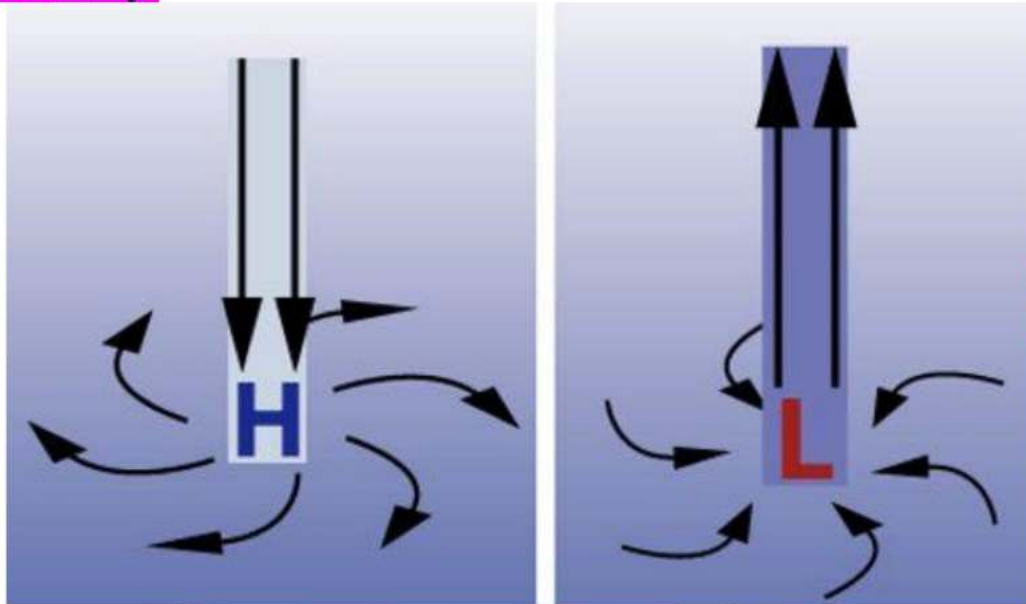
2- High-pressure systems

It is a region where the **pressure at its center is higher** the surrounding. high-pressure system is symbolized by the **letter H in blue color**

The values of atmospheric pressure of isobars decrease as you move away from the center of the high-pressure system.

★ High-pressure regions form descending air currents, rotating outward from the center of pressure in a clockwise direction at the regions located in the Northern Hemisphere.

★ The descending air currents in areas of high-pressure lead to their warming & drying, so the weather in these areas is clear and sunny.



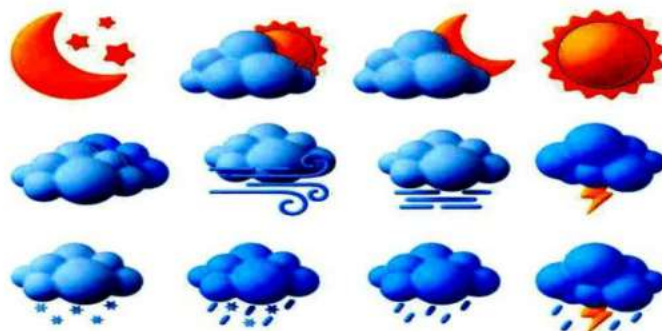
The wind differs from air currents in that

Wind is the movement of air horizontally .

Air currents are the movement of air vertically upward or downward.

Weather forecast maps

Weather maps show a network of isobars & pressure areas over wide regions, while weather forecast maps show icons (symbols) from which the weather conditions can be deduced, with the expected temperature written next to them. (Sunny, Clouds formation, Rainfall , Snowfall ,Thunder, lightning ,Hurricanes)



★ Weather forecast maps are a simplified tool derived from weather maps.

Weather forecasts

It is the process of predicting the future weather conditions for a location.

Weather forecasting is achieved by collecting, recording & analyzing data related to (Temperature, Wind speed, Storm tracks, pressure)

Using instruments & techniques, such as :

1-Stevenson screen(weather station shelter)

1. It is a wooden box, its height is 65 cm painted in white color **G.R.?**

To reflect the sunlight.

2. The wooden box is fixed on a stand 120 cm above the ground level **G.R.?**

To protect the measuring instruments inside it from the heat radiated by Earth.

3. Stevenson screen is placed away from trees & buildings ... **G.R.?**

To avoid any obstacles that may affect the measurements.

4. There are slanted openings in the wooden box ... **G.R.?**

To allow air circulation.

5. there are instruments used to measure (Temperature, Pressure, Humidity).

2-Weather buoys

1. **Used in:** Oceans (float in oceans).

2. **Function:** Collecting the data received from the sensors to organize and process it.

3. The processed data are sent via satellites to observation centers

3-Radiosonde (radio probe)

It consists of: Three parts, which are :

1-Device carrying instruments to measure

(Temperature- Humidity- pressure- Wind speed)

2-Balloon carries the radiosonde device upward ... GR.?

Bec. it is filled with helium or hydrogen gas, due to their low densities.

3-Parachute Opens when the balloon bursts & brings down the radiosonde.

The radiosonde device is launched from hundreds of stations around the world twice daily: Once at noon, Once at midnight.

How does it work?



1) **The size of the balloon increases as it rises upward... G.R.?**

Due to the decreasing of atmospheric pressure as altitude increases.

2) **The data collected by the radiosonde sensors** are transmitted via radio waves to ground stations.

3) **The balloon bursts at an altitude ranges between 20 – 35 km** due to its continuous expansion.

4) **The radiosonde falls by parachute** after the balloon bursts and it is often not reused again.

4-Satellites

That orbit Earth.

5-Weather stations



That are distributed in different regions in all countries of the world.

Weather forecasting is not absolute facts but rather probabilistic predictions .. G.R.?

Because the atmosphere is affected by a large number of variables.

The accuracy of weather forecasting decreases, as the prediction period increases, so forecasting for the next week less accurate than forecasting for only the next two days.

Importance of weather forecasts

There are many fields that benefit from weather forecasts, including:

1. **Protection of lives & property** by taking appropriate preventive measures when there is a probability of occurrence of hot or cold waves, floods, thunderstorms.
2. **Supporting economic activities** by helping farmers determine the timing of planting , irrigation , harvesting crops, pest control, increases agricultural productivity, reduces losses.
3. **Aviation safety** by avoiding weather conditions that may threaten air navigation traffic.

★ **Egypt experiences weather disturbance in the spring season every year, due to the blowing of Khamaseen winds which negatively affect the health of the respiratory system ... G.R.? Because these winds are loaded with sand and dust.**